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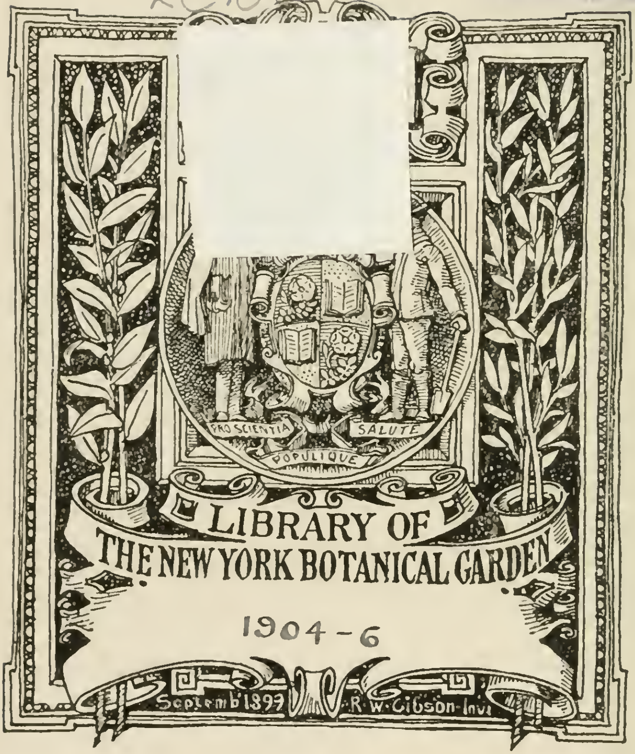
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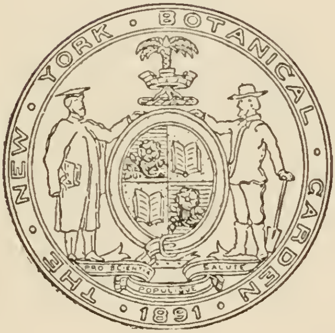

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Vol. 22, part 2, issued December 18, 1905, contains descriptions of the families Saxifragaceae and Hydrangeaceae by Dr. J. K. Small and Dr. P. A. Rydberg; the Cunoniaceae, Iteaceae and Hamamelidaceae by Dr. N. L. Britton; the Pterostemonaceae by Dr. J. K. Small; the Altingiaceae by Percy Wilson and the Phyllonomaceae by Dr. H. H. Rusby.

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CONTRIBUTIONS FROM THE NEW YORK BOTANICAL
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NOTES ON BAHAMAN ALGAE

By MARSHALL A. HOWE

NEW YORK
1904

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, **31**: 93-100. February, 1904]

[From the Bulletin of the Torrey Botanical Club, 31: 93-100. February, 1904.]

Notes on Bahaman algae

Marshall A. Howe

(With plate 6)

A collection of Bahaman algae, mostly marine, secured during the summer of 1903, by Dr. W. C. Coker, of the University of North Carolina, chief of the botanical staff of the Expedition of the Geographical Society of Baltimore to the Bahama Islands,* has been submitted to the writer for determination. This collection includes several rare or novel forms and some of the more interesting have been selected for comment below. Dr. Coker's specimens of algae were all preserved in fluids, either alcohol or solutions of formaldehyde, and they have for this reason proved especially satisfactory for study; though in some cases, as may necessarily happen, the material was less copious than could be desired.

Caulerpa compressa (Web.-v. Bosse).

Caulerpa paspaloides, var. *typica*, f. *compressa* Web.-v. Bosse, Ann. Jard. Bot. Buitenzorg, **15**: 353. *pl. 30. f. 3, 4.* 1898.

In four feet of water, off Clarence Harbor, Long Island, Bahamas, July 16, 1903.

This plant, which agrees closely with Mme. Weber's description and figures, is, we believe, absolutely distinct from *Caulerpa paspaloides* (Bory) Grev. In *C. paspaloides*, the primary pinnules are 3- or 4-ranked, so that the "frond" is distinctly 3- or 4-angled or 3- or 4-winged, a character that is more strikingly apparent in fresh or fluid-preserved material than in dried specimens; the secondary pinnules are pectinately secund along the upper side of the rachis and the lowermost of these secondary pinnules are always much shorter than the rachis itself. In *Caulerpa compressa*, on the other hand, the primary pinnules are so numerous and densely crowded that it is difficult to say how they are arranged, but they are probably 8–12-ranked, and the "frond" is as cylindrical and dense as that of *Dasycladus vermicularis* (Scop.) Krasser; the secondary pinnules are pinnately distichous and corymbose, the lowermost being as long as the rachis or slightly longer; the "pedicel" supporting the four, five, or more digitate primary branches or "fronds" is very short, measuring in Dr. Coker's specimen only 0.5–1.0 cm.

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* For organization of this expedition and outline of its results, see *Science*, II. 18: 427. 2 O 1903.

CAULERPA PASPALOIDES (Bory) Grev.

Green Cay, in 4 fathoms.

RHIPOCEPHALUS PHOENIX (Ell. & Soland.) Kuetz.

Mangrove Cay, Andros, June 26, 1903. Dr. Coker's specimens accord very well with Ellis's original figure * in regard to the outline of the capitulum, but the flabella are broader, more crowded, and more erect. Specimens collected by the writer at Key West, Florida (*no. 1612*, distributed in Phyc. Bor.-Am. as *no. 1030*) are extremely varied as regards the form of the capitulum, only occasionally offering the oblong-ovoid outline figured by Ellis. The capitula of some of these Key West plants are conical, some are broadest near the top, tapering down to the stalk below, and others are much elongated and of uniform width throughout (sometimes 9–10 cm. × 1–1.5 cm.), but these extremes are connected by clearly intermediate forms and we think but one species is represented.

UDOTEA CONGLUTINATA (Ell. & Soland.) Lamour.

Collected by Dr. Coker at several points; at Green Cay in 4 fathoms of water. **Udotea Flabellum** (Ell. & Soland.),† which is much the more common in southern Florida and Porto Rico, does not appear to have been found by Dr. Coker.

MICRODICTYON CRASSUM J. Ag. Anal. Alg. Cont. 1: 107. 1894.

Green Cay, in 4 fathoms. We are using provisionally for these plants collected by Dr. Coker the specific name applied by J. Agardh to specimens from the Bahamas sent to him by Mrs. Curtiss, though it is not yet wholly clear how either are to be kept separate from *Microdictyon umbilicatum* (Velley) Zanard. J. Agardh in proposing *M. crassum* as a new species appears to have been influenced chiefly by the "articulis multo brevioribus quam in aliis speciebus" * * * * "diametro vix longioribus." But the articuli of the original *Conferva umbilicata* as figured by Velley (Trans. Linn. Soc. **5**: *pl. 7.* 1800) are also often "diametro vix longioribus," even though J. Agardh * describes the articuli of *Microdictyon umbilicatum* as "circiter 4-plo longioribus." Velley's specimens were from New South Wales, and J. Agardh's remark, "Quae prima vice ad insulas Sandwich detecta fuit *C. umbilicalis*, eandem quoque ad Novam Hollandiam obvenire statuit C. Agardh (*Syst. p. 85*)," seems to indicate that he had seen neither the original plants nor the original description and figures of the first-described species of the genus.

---

* Ell. & Soland. Nat. Hist. Zooph. *pl. 25. f. 2.* 1786.

† *Corallina Flabellum* Ell. & Soland. Nat. Hist. Zooph. 124. *pl. 24.* 1786. *Udotea flabellata* Lamour. Hist. Polyp. 311. 1816.

Coccocladus † **occidentalis laxus** var. nov.

Fertile plants reaching 7 cm. in height and 10–13 mm. in width, flaccid: sporangia obovoid, oblong-ellipsoidal, or pyriform-subclavate, 460–880 μ × 315–430 μ, often twice as long as broad, lateral or occasionally terminal at the ends of branches of the first three (rarely four) orders: aplanospores for a long time closely coherent in a single peripheral layer surrounding a central cavity, radially elongated, 66–85 μ × 55–72 μ, mostly 1½ times as long as broad, usually angular-obovoid or ellipsoidal. (PLATE 6, FIGURES 1 AND 2.)

In small sink-holes by Big Pond, Nassau, June 23, 1903.

This remarkable plant is so strikingly different from the usual form of *Coccocladus occidentalis* as to suggest at first sight not only a distinct species, but even a different genus, yet in the presence of some apparently intermediate forms from other collections we dare not propose for it a rank higher than that of variety; though it is possible that a fuller knowledge of its life-history would lead to another conclusion. Dr. Coker writes that the plant grows "about one mile inland," in slightly brackish water which responds to the changes of the tide. The lax habit, the elongated sporangia, and extension of the sporangium-bearing capacity to branches of the third (and even the fourth) order are in harmony with the variations which the recent researches of Dr. Livingston * might lead us to expect would occur in a transition from salt to fresh or slightly brackish water. The variety *laxus* is almost destitute of the yellowish staining matter which manifests itself so conspicuously in ordinary specimens of this genus whether dried or preserved in fluids. In all conditions of *Coccocladus*, the sporangia appear to mature almost simultaneously in all parts of a plant, so that a considerable number of fertile individuals is needed to follow out the stages of spore-formation. In Dr. Coker's material of the variety *laxus*, there occur two or three plants with smaller pyriform-obovoid sporangia showing numerous chlorophyl-bodies, but apparently no spores; these we take to be immature aplanosporangia, but in the absence of direct observation of intervening stages the possibility that they represent sporangia of a different sort has suggested itself.

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* *l. c.* 105.

† COCCOCLÁDUS Cramer, Neue Denkschr. Schweiz. Naturf. Ges. **30**: — (37). 1887.

Botryophora J. Ag. Till Alg. Syst. **5**: 139. 1887. Wille, E. & P. Nat. Pflanzenfam. 1²: 157. 1891. Not *Botryophora* Bompard, Hedwigia, **6**: 129. 1867. The generic type of *Coccocladus*, as also of J. Agardh's *Botryophora*, is *Dasycladus occidentalis* Harv. Ner. Bor.-Am. **3**: 38. *pl. 41 B.* 1858.

Coccocladus occidentalis laxus evidently has a closer affinity with **Coccocladus occidentalis Conquerantii,**† judging from Cramer's description, than with the typical *C. occidentalis*, but, we believe, differs too much from that to bear the same varietal name. The sporangia of *C. occidentalis Conquerantii*, according to Cramer, are at most only slightly ellipsoidal and occur only on branches of the first two orders. The number of spores to a sporangium and the size of the spores, characters which are in part relied upon by Cramer to separate his *Botryophora Conquerantii* from his *B. occidentalis*, appear in a considerable series of specimens of this genus now accessible to be extremely variable and unreliable for a specific separation. And Cramer's selection of a comparatively few-spored form for the typical *C. occidentalis* is hardly justified in view of Harvey's description of the spores as "innumerable," a characterization that is well substantiated by specimens of Harvey's collecting at Key West now in the herbarium of Columbia University, in which the number of spores to a sporangium is 200 or more. The peripheral arrangement of the spores about a central cavity, which Cramer emphasizes as a distinctive character of his *Botryophora Conquerantii*, and which that variety has in common with our variety *laxus*, seems to be more constant than number and size of spores and may be more significant. Specimens agreeing essentially with Cramer's description of *Botryophora Conquerantii* have been collected by the writer at Key West, Florida (*no. 1531*).

---

* Livingston, B. E. On the Nature of the Stimulus which causes the Change of Form in Polymorphic Green Algae. Bot. Gaz 30: 289–317. *pl. 17, 18.* 1900.

——. The Rôle of Diffusion and Osmotic Pressure in Plants. Dec. Publ. Univ. Chicago, II. 8. 1903.

† *Dasycladus Conquerantii* Crouan; Schramm & Mazé, Alg. Guadeloupe, 47 1865. Mazé & Schramm, Alg. Guadeloupe, 108. 1870–77.

Botryophora Conquerantii (Crouan) Cramer, Neue Denkschr. Schweiz. Naturf. Ges. 32: 6. *pl. 4. f. 1.* 1890.

Neomeris Cokeri sp. nov.

Plants subcylindrical or clavate, 7–14 mm. long, 1.5–2.5 mm. thick, dark green in upper third or fifth, becoming grayish white below, apex rounded-obtuse or subtruncate, often exhibiting a delicate, translucent apiculum formed of the mantle-caps:* number of successive whorls of branches mostly 60–120; number of branches in a whorl 12–56: hairs of two forms in separate zones, those of one form consisting of a single, clavate, often curved or somewhat hooked cell rich in chlorophyl and having a maximum diameter about equal to that of the supporting cell, the apex acute, obtuse, or more often apiculate; those of the second form consisting of a somewhat similar though slightly narrower basal cell bearing at its apex one or two earlier caducous, more slender branches, these in turn each bearing 2–4 branches; unicellular hairs or basal cells of the multicellular persisting in the upper third or fifth of the plant, the surface after their fall appearing somewhat shaggy or minutely and irregularly punctate, a cortex scarcely developed: branches of the first order lightly calcified, scarcely coherent; branches of the second order more strongly calcified, irregularly and imperfectly coherent, subfusiform, often somewhat curved or gibbous, broadest (100–150 μ) a little above the middle, tapering to a conico-truncate apex 22–34 μ broad at the insertion of the hair: sporangia strongly calcified, free or coherent in short rows of 2–8, pyriform-obovoid, 180–206 μ long (decalcified and including stalk), 90–102 μ in maximum width, calcareous capsule 25–40 μ thick; spores obovoid, 140–156 μ × 82–94 μ. (PLATE 6, FIGURES 3–12.)

Opposite Current Town, Eleuthera, July 5, 1903. The material collected consists of about thirty individuals.

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* "Kappentheile oder Mantelkappen" of Cramer, Neue Denkschr. Schweiz. Naturf. Ges. **32**: 12. 1890.

Neomeris Cokeri constitutes the third known species of the genus, all of which occur in the West Indian region. The principal diagnostic characters of the three species may be arranged as follows:

Hairs homogeneous; ends of the branches of the second order forming a cortex with distinct facets.
  Plant reaching a height of 3.5 cm.; sporangia spherical or nearly so, strongly calcified but free. 1. *N. dumetosa*.[*]
  Plant reaching a height of 2 cm.; sporangia obovoid-oblong or pyriform-obovoid. about twice as long as broad (not including stalk), strongly coherent laterally by their calcareous capsules, so that the plant in the lower fertile parts appears transversely annulate. 2. *N. annulata*.[†]
Hairs dimorphous, the two forms in different zones; branches of the second order subfusiform, scarcely forming a cortex, surface of the plant after the fall of the hairs somewhat shaggy or minutely and irregularly punctate; sporangia free or coherent in short rows of 2–8. 3. *N. Cokeri.*

Neomeris annulata is not especially uncommon in the West Indian region. The writer has collected specimens in Bermuda, Key West, Florida (two stations) and Porto Rico (three stations). Of what appears to be the true *N. dumetosa*, we have seen only one specimen — the one from Hawaii distributed as *Neomeris dumetosa* by Miss Tilden in American Algae, *no. 445*. *No. 668* of the Phycotheca Boreali-Americana (St. Thomas, *Börgesen*, Jan. 1896) distributed as *Neomeris dumetosa* has, in the two copies seen, the characters of *N. annulata*. The original description of *Neomeris dumetosa*, as given by Lamouroux, with its "bulles conoïdes ou pédiculées, se touchant entre elles tant elles sont nombreuses, mais sans être coalescentes," combined with Cramer's redescription of the original material (collected in the Antilles by Richard) can leave little doubt as to what *Neomeris dumetosa* really is. The type of *Neomeris annulata* came from Mauritius, where it was collected by Colonel Nicolas Pike. The species is not represented in Colonel Pike's herbarium, now in the possession of the New York Botanical Garden, but Count Solms has seen [*] the original material preserved in the British Museum and his figures drawn from Mauritius specimens would apply very well to the specimens from Bermuda, Porto Rico, and St. Thomas, alluded to above. Solms-Laubach refers Porto Rican material to this species, using the name *Neomeris annulata*, and Cramer refers to the same both Porto Rican and Bermudian specimens, preferring, however, the name *Neomeris Kelleri*.

---

[*] NEOMERIS DUMETOSA Lamour. Hist. Polyp. 243. *pl. 7. f. 8.* 1816. Sonder, Alg. Trop. Austral. *pl. 5. f. 8–13.* 1871. J. Ag. Till Alg. Syst. 5: 147–151. *pl. 2. f. 4–7.* 1887. Cramer, Neue Denkschr. Schweiz. Naturf. Ges. 30: —(10, 38) *pl. 2. f. 13–15; pl. 3. f. 3.* 1887. Cramer, *op. cit.* 32: 19. *pl. 1. f. 13.; pl. 2. f. 7, 8.* 1890. De-Toni, Syll. Alg. 1: 413. 1889. Solms, Ann. Jard. Bot. Buitenzorg, 11: 70. *pl. 8b. f. 11.* 1893.

[†] NEOMERIS ANNULATA Dickie, Jour. Linn. Soc. 14: 198. 1874. De-Toni, Syll. Alg. 1: 414. 1889. Solms, Ann. Jard. Bot. Buitenzorg, 11: 61–71. *pl. 8. f. 1, 3, 4, 7, 8, 12, 13,* 17. 1893.

Neomeris Kelleri Cramer, Neue Denkschr. Schweiz. Naturf. Ges. 30: —(3). *pl. 1; pl. 2. f. 1–12; pl. 3. f. 1, 2.* 1887. Cramer, *op. cit.* 32: 9. *pl. 1. f. 1–12; pl. 2. f. 1–6; pl. 4. f. 15–24.* 1890. De-Toni, Syll. Alg. 1: 413. 1889.

Neomeris Eruca Farlow; Cramer, Neue Denkschr. Schweiz. Naturf. Ges. 32: 9, 18, 19. 1890.

The names *Dactylopora Eruca*, *D. digitata*, and *D. Annulus* of Parker and Jones (Ann. and Mag. Nat. Hist. III. 5: 473, 474. 1860), quoted by Cramer in the synonymy of his *Neomeris Kelleri*, were originally applied simply to calcified spore-masses and fragments of a *Neomeris* from the "East Indian and other tropical seas," and cannot, in our opinion — especially since the discovery of *Neomeris Cokeri* with its peculiar hairs — be safely identified with any definite species, though as between *Neomeris dumetosa* and *N. annulata*, *Dactylopora Eruca* and *D. Annulus* clearly belong with the latter type. The name *Neomeris Eruca* Farlow apparently was first published by Hauck in Engler's Bot. Jahrb. (9: 469. 1888) but this, so far as the technicalities of publication are concerned, rests on the *Dactylopora Eruca* synonym alone, and is therefore, we believe, of uncertain application.

CYSTOSEIRA MYRICA (Gmel.) Ag.

Gregory Town, Eleuthera.

LIAGORA ANNULATA J. Ag.

Gregory Town, Eleuthera.

Somewhat resembling *Liagora valida* in habit, but clearly distinct — firmer, beautifully annulate from near the base to the partially calcified apices; the apices are rounded-obtuse in fluid-preserved material, but often become attenuate-acuminate on drying. The annulations appear to be due to unequal calcification in well-defined alternating zones.

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[*] Ann. Jard. Bot. Buitenzorg, 11 : 61. 1893.

Explanation of plate 6

Figs. 1 and 2. *Coccocladus occidentalis laxus*; 3–12, *Neomeris Cokeri.*

1. One of the whorled branches of *Coccocladus occidentalis laxus*, with sporangia, × 12.

2. A single sporangium, × 40.

3. *Neomeris Cokeri*, natural size.

4. A single plant, × 8. At the apex, in this individual, is a zone of multicellular hairs, surrounding and concealing the apiculum formed of the mantle-caps; below, are the unicellular hairs, and farther downward, the lime-coated sporangia, isolated, or coherent in short rows.

5. Apical portion of another plant, × 12. The hairs in the apical region are here of the unicellular kind and the apiculum formed of the mantle-caps is conspicuous; below is a zone of multicellular hairs.

6. A fertile primary branch, with branches of the second order, each, in this case, bearing a unicellular hair, × 40. (Decalcified.)

7. A similar fertile primary branch, × 40. (Decalcified.)

8. A fertile primary branch, with branches of the second order, each, in this case, bearing a multicellular hair, × 40. (Decalcified.)

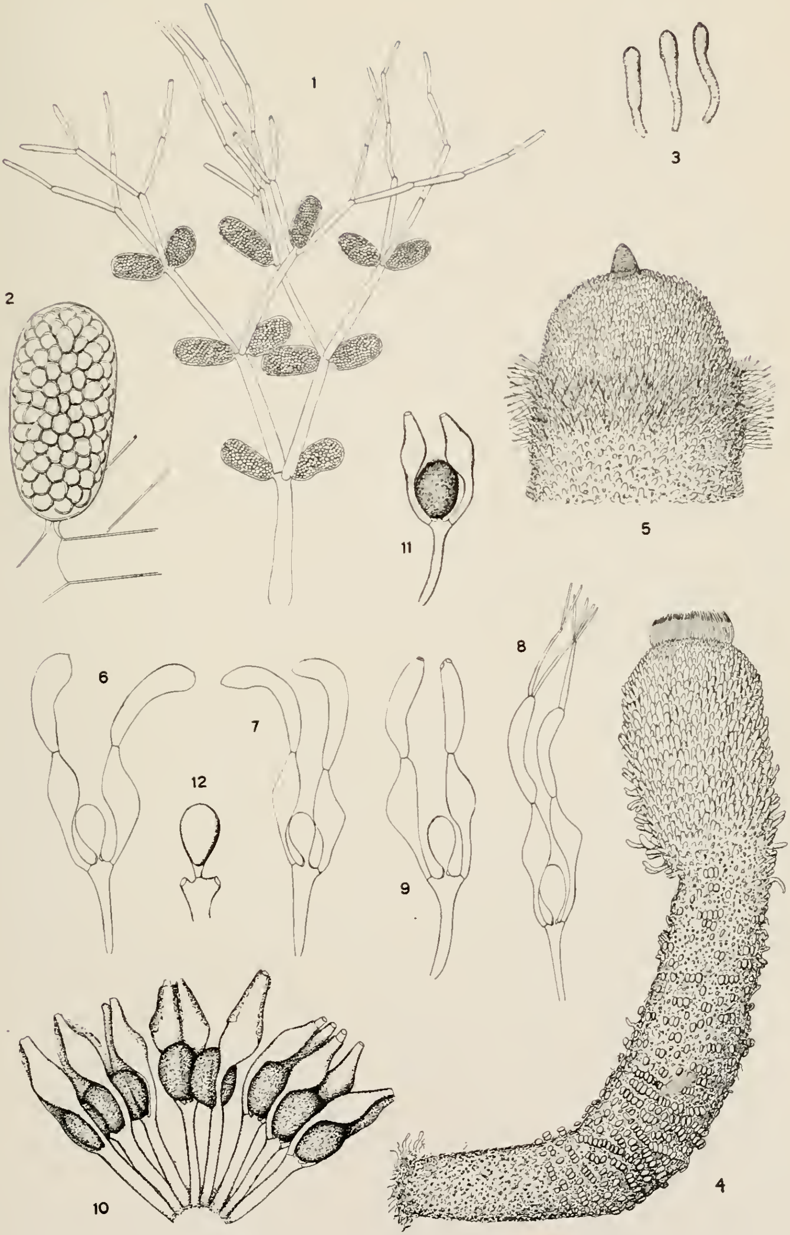
9. The conditions in this figure are similar to those represented in Fig. 8, except that only the basal cells of the multicellular hairs now persist. Scars remain indicating the places of insertion of the hair-segments which have fallen. In this stage the two forms of hairs sometimes resemble each other, but the persisting bases of the multicellular may be recognized by the presence of these scars, which are always entirely wanting on hairs of the unicellular kind.

10. Part of a primary whorl, with sporangia and branches of the second order, × 40, with calcareous coating.

11. A single primary branch, with sporangium and branches of second order, with calcareous coating, × 37.

12. A mature spore, within the sporangium, decalcified, × 53.

The drawings have been made by the writer, with some assistance from Mr. A. Mariolle in preparing them for reproduction.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1, 2 Coccocladus occidentalis laxus M. A. Howe
3–12 Neomeris Cokeri M. A. Howe

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THE POLYPORACEAE OF NORTH AMERICA—VII.

THE GENERA HEXAGONA, GRIFOLA, ROMELLIA, COLTRICIA AND COLTRICIELLA

By WILLIAM ALPHONSO MURRILL

NEW YORK
1904

[From the Bulletin of the Torrey Botanical Club, 31: 325-348. June, 1904]

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The Polyporaceae of North America — VII. The genera Hexagona, Grifola, Romellia, Coltricia and Coltriciella

WILLIAM ALPHONSO MURRILL

In the last article of this series (Bull. Torrey Club, **31** : 29–44. 1904), the tough, wood-loving, central-stemmed polypores were discussed under the genus *Polyporus*. The genus *Hexagona* is in general readily distinguished from *Polyporus* by its lateral stem and peculiar pores, but the two genera approach very near to one another in some of their forms. Species of *Grifola* are large, fleshy to tough and much branched, usually growing at the bases of trees or arising from buried wood. The genera *Romellia*, *Coltricia* and *Coltriciella*, although belonging to the brown-fleshed section, are conveniently introduced here because their species are stipitate and are ordinarily associated with the stipitate forms already discussed. This latter group, moreover, is indirectly related to *Grifola* through the genus *Romellia*, with its hyaline spores, large, irregular pileus and thick, rather fleshy substance.

HEXAGONA Poll. Pl. Nov. 35. *pl. 2, 3.* 1816.

This genus was founded upon *Hexagona Mori*. The genus *Favolus* was based on *Favolus hirtus*. Both genera are monotypic in origin. Unfortunately the two were interchanged by Fries, who was unfamiliar with the species, and they have been improperly used ever since. In the Systema, Fries followed Beauvais and included *Hexagona* under the subgenus *Favolus* of *Polyporus*. In the Epicrisis, Fries includes *F. hirtus*, Beauvais' type, in the genus *Hexagona* and follows it with *H. Mori*, Pollini's type. He then begins his genus *Favolus* with *F. europaeus*, a synonym of *H. Mori*.

The genus *Hexagona* comprises species with radially elongated pores having normally six angles. In some species, the usual form of the pores is not so evident, but general appearance and habit serve to indicate generic limits. The line of demarcation between this genus and *Polyporus* is difficult to draw. Most of the species of *Hexagona* are laterally stipitate or almost sessile, but some of them vary to centrally stipitate forms and a few species are regularly mesopous. All grow upon dead wood and agree closely in habit and host plants. One American species is common also in Europe, the others are limited to either temperate or to tropical regions of America. Many of them are very imperfectly known.

Synopsis of the North American species

1.	Tubes unequally hexagonal, the radial walls longer.	2.
	Tubes equally hexagonal	15.
2.	Pileus white or nearly so.	3.
	Pileus purple or brown.	12.
3.	Surface of pileus glabrous or minutely hairy or fibrillose, not distinctly hispid or tomentose.	4.
	Surface of pileus distinctly hispid or tomentose.	9.
4.	Pileus reniform at maturity, stipe usually much reduced; species not tropical.	5.
	Pileus flabelliform, stipe usually very distinct, equalling the pileus at times in length; species tropical.	6.
5.	Tubes large, surface of pileus decorated with imbricated reddish-brown fibrils, which disappear with age.	1. *H. alveolaris.*
	Tubes much smaller, the mouths rarely over 1 mm. long and 0.5 mm. broad, surface of pileus glabrous.	2. *H. micropora.*
6.	Tubes of medium size; pileus large and tough, margin not ciliate.	3. *H. daedalea.*
	Tubes large, mouths 1–2 mm. broad and 3–5 mm. long.	7.
7.	Margin much lobed and fissured at maturity.	4. *H. Wilsonii.*
	Margin entire.	8.
8.	Pileus small, 5 cm. in breadth.	5. *H. hispidula.*
	Pileus large, 10 cm. in breadth.	6. *H. princeps.*
9.	Surface not tessellated.	10.
	Surface tessellated.	11.
10.	Tubes large, the mouths 1 x 4 mm., becoming radially confluent and gill-like; context only partially translucent.	7. *H. fragilis.*
	Tubes small, the mouths about half as large as in the preceding and not becoming confluent; context thinner, wholly translucent.	8. *H. floridana.*
11.	Pileus small, thin and fragile, the surface minutely checkered.	9. *H. tessellatula.*
	Pileus large, thick and firm, the surface coarsely checkered.	10. *H. caperata.*
12.	Pileus purple or purplish-brown, stipe lateral or excentric.	13.
	Pileus brown, stipe distinctly central.	14.
13.	Tubes merulioid.	11. *H. brunneola.*
	Tubes of normal length.	12. *H. purpurascens.*
14.	Margin entire.	13. *H. portoricensis.*
	Margin ciliate.	14. *H. hondurensis.*

15. Pileus purple. 15. *H. indurata.*
Pileus yellow or brown. 16.

16. Margin papulose. 16. *H. cucullata.*
Margin not papulose. 17. *H. Taxodii.*

1. **Hexagona alveolaris** (DC.).

Merulius alveolaris DC. Fl. Fr. **6**: 43. 1815.
Hexagona Mori Poll. Pl. Nov. 35. *pl. 2, 3.* 1816.
Boletus arcularius Schw. Syn. Car. 69. 1818.
Cantharellus alveolaris Fr. Syst. Myc. **1**: 322. 1821.
Favolus canadensis Kl. Linnaea, **7**: 197. 1832.
Favolus europaeus Fr. Epicrisis, 498. 1838.
Favolus ohiensis Berk & Mont. Syll. Crypt. 171. 1856.
Favolus alveolaris Quél. Enchiridion, 185. 1886.—Fairman, Proc. Rochester Acad. Sci. **2**: 162. 1895.

This common and widely distributed species has been several times described, the earliest name having been assigned to specimens from Europe. No mention is made of the American plant in the description of *M. alveolaris* from southern France. The plant was apparently known to Fries under its earliest name in 1821, but in 1838 he redescribed it under the name *Favolus europaeus*, even the genus being different. *F. canadensis* was described from a single specimen in Hooker's herbarium. The excellent description of *F. ohiensis* was drawn from several specimens sent from Columbus, Ohio, by Sullivant. In addition to the names listed above, the species has been reported under several others, notably *F. Boucheanus* Kl. (Linnaea, **8**: 316. *pl. 5. f. 2.* 1833) and *F. alutaceus* Berk. & Mont. (Ann. Sci. Nat. Bot. III. **11**: 240. 1849). The former was originally collected by Bouché on dead trunks of birch at Lankwitz near Berlin. The latter was described from Bahia, Brazil, and probably does not extend even into tropical America. Faded specimens of *H. alveolaris*, collected especially in the South during late autumn or winter, resemble the Brazilian species in some ways, but authentic plants show them to be very distinct. Var. *peponinus* B. & C. of *F. Boucheanus* was doubtless based on these same faded forms of our common species.

In the exsiccati listed, only American material is considered. The species grows upon dead wood, usually fallen limbs, of various deciduous trees. In New York it appears to be most common on species of hickory: Canada, *Dearness*, *Macoun*; New Hampshire. *Lobenstine*; Connecticut, *White*, *Earle*; New York, *Underwood*, *Clinton*, *Brown*, *Murrill*, *Overacker*, *Earle*; Pennsylvania, *Haines*, *Everhart*; New Jersey, *Ellis*; Ohio, *James*, *Morgan*; Virginia, *Murrill*; Georgia, *Ravenel*; Alabama, *Earle*; Michigan, *Hicks*, *Johnson*; Wisconsin, *Calkins*; Montana, *Anderson*.

2. **Hexagona micropora** sp. nov.

Pileus flabelliform to reniform, convex, usually umbilicate or depressed behind, 2–4 × 2.5 × 0.2–0.4 cm.; surface smooth, glabrous, straw-colored to cream-colored, margin acute, undulate or slightly lobed, rarely reflexed, irregularly denticulate, dark brown, as if scorched: context white, 1–2 mm. thick; tubes decurrent, ochraceous, 1–2 mm. long, mouths 4–6 angled, 0.3–0.5 × 0.6–1 mm., edges rather firm, beset with small, sharp teeth; spores ellipsoidal, smooth, hyaline, 3 × 9 μ; stipe lateral to excentric, slightly enlarged below, concolorous, minutely tomentose to subglabrous, 1–7 mm. long, 3–5 mm. thick.

The type plants of this species were collected by Miss V. S. White on a dead birch tree at Bar Harbor, Maine, August 4, 1901. Other collections are at hand from Ohio, *Kelsey*; New York, *Britton*; New Jersey, *Ellis*; Wisconsin, *Baker*. Specimens were also found in the Fries herbarium at Upsala sent from New York by Peck. In habit and general appearance it resembles *H. alveolaris*, but it is much rarer and seems confined to the northern states, while the glabrous surface and very much smaller tubes easily distinguish it from that species.

3. **Hexagona daedalea** (Link)

Merulius daedaleus Link, Disser. **1**: 37. 1795.
Daedalea braziliensis Fr. Syst. Myc. **1**: 332. 1821.
Favolus braziliensis Fr. Elench. Fung. 44. 1828; Linnaea, **5**: 511. *pl. 11. f. 1.* 1830.

This species was originally described from Brazil, but it extends as far north as Florida and is quite abundant in tropical America on fallen trunks and other decayed timber. Besides the synonyms cited above, there are doubtless several more recent ones assigned by those who have worked over South American material. On the other hand, some species have been treated as forms of this one which are really distinct. *Favolus tessellatus* Mont. (Ann. Sc. Nat. II. Bot. **20**: 365. 1843), a good Brazilian species, was at first determined as *F. braziliensis* by Montagne and later separated because of its distinctly tessellated or checkered surface and regularly hexagonal pores. Cuban specimens called *F. tessellatus* are plainly *F. braziliensis*, and are so determined at Kew by Montagne.

Exsiccatae: Texas, *Wright;* Louisiana, *Hale*, *Langlois;* Cuba, *Underwood & Earle;* San Domingo, *Wright;* Brazil, *Telinck.*

4. **Hexagona Wilsonii** sp. nov.

Pileus flabelliform, applanate, 4–7 × 4–9 × 0.05–0.2 cm.; surface radiate-striate, slightly hispid, partially tessellate, pure white, becoming cream-colored on drying; margin at maturity very thin, usually much lobed and fissured, beset with short, fugacious hairs: context fleshy-tough, membranous, white, partially or wholly translucent; tubes decurrent, white, 1–2 mm. long, 4–6 angled, mouths 1.5 × 5 mm., smaller near the margin, edges very thin, splitting into irregular teeth; spores ellipsoidal, smooth, hyaline, 5 × 10 μ; stipe exactly lateral, equal, concolorous, hispid, 0.5–1 cm. long, 2.5–5 mm. thick, often umbilicate above where it expands into the pileus.

This elegant species was collected by Percy Wilson (*no. 317*) in July, 1902, in the Luquillo mountains, Porto Rico, three miles from the coast. Decaying logs along a mountain stream were found covered with the fruit-bodies.

5. **Hexagona hispidula** (B. & C.)

Favolus hispidulus B. & C. Jour. Linn. Soc. Bot. **10**: 321. 1868.

Collected on trunks in Cuba by Wright.

6. **Hexagona princeps** (B. & C.)

Favolus princeps B. & C. Jour. Linn. Soc. Bot. **10**: 321. 1868.

Collected on dead wood in Cuba by Wright. The type is at Kew. It is a large, handsome species.

7. **Hexagona fragilis** sp. nov.

Pileus flabelliform, convex, depressed behind, 2–3 × 2–4 × 0.1–0.3 cm.; surface densely hispid, especially behind, faintly radiate-striate, pure white, becoming straw-colored in drying; margin quite thick for the genus, nearly regular in outline, usually inflexed when dry, partly hygrophanous at times, beset with short, fimbriate, fugacious hairs: context thin, white, partially translucent, quite fragile when dry; tubes decurrent, white, 2–3 mm. long, 4–6 angled, mouths 1 × 4 mm., becoming radially confluent and gill-like, edges thin, lacerate, the divisions fimbriate; spores ellipsoidal, smooth, hyaline, 4–5 × 10 μ; stipe lateral, subequal, concolorous, hispid, short, 5 mm. long, 2.5 mm. thick, rarely umbilicate above.

About twenty specimens of this plant were collected by Earle (*no. 585*) during a recent visit to Jamaica. They were found on fence-posts made of "star-apple" (*Chrysophyllum*).

8. **Hexagona floridana** sp. nov.

Pileus flabelliform, applanate, depressed behind, 2 × 2.5–3 × 0.2 cm.; surface finely hispid, pure white becoming straw-colored on drying, faintly radiate-striate; margin slightly undulate, tessellate at times, fringed with numerous slender cilia: context very thin, white, membranous, wholly translucent; tubes decurrent, white, becoming ochraceous, 1.5–2 mm. long, normally hexagonal, mouths 0.5–1 × 2–3 mm., not radially confluent, edges thin, fimbriate; spores ellipsoidal, smooth, hyaline, 9 × 4 μ; stipe lateral, subequal, scutate at the base, concolorous, hispid, 2–5 mm. long, 1–2 mm. thick, always umbilicate above.

This species was collected by Small & Wilson near Miami, Florida, May, 1904. About thirty sporophores in various stages of development were taken from an old decaying log in rich shady woods.

9. **Hexagona tessellatula** sp. nov.

Pileus flabelliform, convex, depressed behind, 1–3 × 2–4 × 0.2 cm.; surface delicately and closely tessellate, finely hispid, becoming glabrous, white, yellowish when dry; margin thin, denticulate, slightly incurved when dry, frequently brown and hygrophanous: context white, membranous, translucent; tubes decurrent, white, 2 mm. long, 4–6 angled, mouths 1 × 3 mm., at length radially confluent, edges thin, lacerate; spores ellipsoidal, smooth, hyaline, 2-guttulate, 3 × 10 μ; stipe lateral, short, slightly enlarged below, concolorous, hispid, 3–5 mm. long, 2–3 mm. thick, usually umbilicate above.

This species was recently collected on dead wood in Cuba by Underwood and Earle (*no. 1212*). About twenty fruit-bodies were preserved.

10. **Hexagona caperata** (Pat.)

Favolus caperatus Pat. Bull. Soc. Myc. **18**: 171. 1902.

Described from Guadeloupe collections. Easily recognized by the abundant villosity which covers the cap. Plants recently collected by Earle at Port Antonio, Jamaica, agree well with the description.

11. **Hexagona brunneola** (B. & C.)

Favolus brunneolus B. & C. Jour. Linn. Soc. Bot. **10**: 321. 1868.

Collected on dead wood in Cuba by Wright. One small specimen is at Kew. The tubes are merulioid in their brevity, the dissepiments being mere lines. I was at first inclined to consider the species an undeveloped stage of *H. purpurascens*, but the two species were originally described at the same time and declared by their authors to be most distinct.

12. **Hexagona purpurascens** (B. & C.)

Favolus purpurascens B. & C. Jour. Linn. Soc. Bot. **10**: 321. 1868.

Collected by Wright on trunks in Cuba. Easily distinguished from most other species by its purple color.

13. **Hexagona portoricensis** sp. nov.

Pileus centrally stipitate, circular, deeply umbilicate, × 4 0.3 cm.; surface subglabrous, umbrinous, the centre concolorous; margin entire, not very thin, much inflexed when dry: context white, fibrous, 1 mm. thick, opaque; tubes somewhat decurrent, white, 2 mm. long, 4–6 angled, mouths 1 × 3 mm., smaller and more regular near the margin, edges thin, fimbriatulate; spores ellipsoidal, smooth, hyaline, 2-guttulate, 3–5 × 8–10 μ; stipe central, compressed, slightly tapering downward, subconcolorous, minutely tomentose, 2 cm. long, 4 mm. thick.

The above description is based on *no. 145* of Earle's Porto Rican collections. The plant was found upon decaying wood in the mountains at an altitude of 2,000 feet. It has many characters in common with *H. hondurensis*.

14. **Hexagona hondurensis** sp. nov.

Pileus centrally stipitate, circular, slightly umbilicate, 2–4 × 0.05 cm.; surface faintly radiate-striate, subglabrous, fulvous, the center fuliginous; margin thin, regular, tessellate, inflexed when dry, fringed with numerous short, fugacious cilia: context white, fibrous, 0.25 mm. thick, translucent near the margin; tubes adnate, white, 0.3 mm. long, hexagonal, radially elongated, mouths 1 × 2 mm., much smaller near the margin, edges thin, subentire; spores ellipsoidal, smooth, hyaline, 3.5 × 9 μ; stipe central, equal, concolorous, pruinose to glabrous, 2–3 cm. long, 2 mm. thick.

This species is described from plants collected in Honduras by Percy Wilson (*no. 640*) March, 1903. They grew on dead logs by the shore of a lagoon not far from the coast. All stages are represented.

15. **Hexagona indurata** (Berk.)

Favolus induratus Berk. Ann. Nat. Hist. II. **9**: 198. 1852.

Collected on wood in San Domingo. The type plants are at Kew. If the tubes alone were considered, this species would belong rather with *Favolus*. It differs from *H. cucullata* in having larger tubes, and being purple in color.

16. **Hexagona cucullata** (Mont.)

Favolus cucullatus Mont. Pl. Cell. Cuba, 378. *pl. 14. f. 2.* 1842.

Montagne's type from Cuba is well described and figured in the work cited. Although the tubes are regularly hexagonal, it seems best to place the species in *Hexagona* because of general appearance, structure and habit. Berkeley considered *Favolus curtipes* B. & C. (Kew Misc. **1**: 234. 1849) a synonym of Montagne's species, remarking that plants collected in San Domingo exactly connect the Cuban species with that described from South Carolina.

17. **Hexagona Taxodii** sp. nov.

Pileus reniform, applanate, umbonate-sessile, 3–6 × 6–8 × 0.2 cm.; surface glabrous, radiate-striate, cream-colored to ochraceous, marked with two or three broad undulations from center to margin, which is thin, entire, irregularly undulate or lobed and deflexed when dry: context tough, white, homogeneous, 0.5 mm. thick; tubes dark fulvous, hexagonal, not radially elongated, 1.5 mm. long, 1 mm. wide, edges thin, finely denticulate; spores ellipsoidal, smooth, hyaline, 14 × 7 μ, copious; stipe a mere scutate disk nearly a centimeter in breadth.

The type collection of this species was made by Small & Wilson near Miami, Florida, May, 1904. The sporophores were found a few feet from the ground on a decaying standing trunk of cypress (*Taxodium distichum*) in damp rich woods near the Miami river. Other plants were collected near the type locality by Mr. McCullough of the Miami Experiment Station.

SPECIES INQUIRENDAE

Favolus Friesii B. & C. Jour. Linn. Soc. Bot. **10**: 321. 1868. First collected on decayed wood at San José, Costa Rica, and called *Favolus lacerus* by Fries, who later (Nov. Symb. 104. 1851) assigned it to *F. flaccidus* Fr. (Linnaea, **5**: 511. 1830), a species collected in Brazil by Beyrich, in whose herbarium it was called *Cantharellus aequinoctialis* Link. The original name was changed by Berkeley and Curtis because of *Favolus lacerus* Lév., described from Java. The Cuban plant at Kew seems only a form of *H. daedalea*, but it is very likely that the one from Costa Rica is different.

Favolus curtipes B. & C. Hook. Jour. Bot. **1**: 234. 1849. "Pileus reniform, two inches broad, one and one-half inches long, quite smooth, rigid, and tawny when dry. Stem extremely short, disciform. Pores one-thirty-sixth of an inch broad, pale, undulated, and crisped; edge white." Said by the authors to differ from *F. cucullatus* Mont. in having less rigid and smaller pores and more fleshy substance.

Favolus guadalupensis Lév. Ann. Sc. Nat. III. Bot. **5**: 144. 1846. Collected on trunks in Guadeloupe by L'Herminier. Infundibuliform specimens of *H. daedalea* agree fairly well with the description of this species.

Favolus velutipes Fr. Nov. Symb. 104. 1851. Collected by Oersted at San José, Costa Rica. Pileus fan-shaped, smooth, ferruginous; stipe very short, pubescent.

GRIFOLA S. F. Gray, Nat. Arr. Brit. Pl. **1**: 643. 1821.

Polypilus Karst. Rev. Myc. **3**: 17. 1881.

Meripilus Karst. Bidr. Finlands Nat. och Folk. **37**: 33. 1882.

Cladomeris Quél. Enchiridion, 167. 1886.

The genus *Grifola* was founded on *Grifola frondosa* and five other species with lateral stem and semicircular cap, *i. e.*, *G. platypora*, *G. cristata*, *G. lucida*, *G. badia* and *G. varia*. Of these last only *G. cristata* is congeneric with the type, the others belonging to *Polyporus* and *Ganoderma*. In Karsten's arrangement of the group, *P. frondosus* with *P. confluens* and *P. sulfureus* form the basis of a new genus, *Polypilus*, Gray's genus *Grifola* not being considered. So, again, Quélet establishes his genus *Cladomeris* on *P. umbellatus* and sixteen other species, ignoring the work of both Karsten and Gray.

The plants of the genus *Grifola* are large and striking in appearance and sometimes attractive in coloring. They are intricately branched or irregularly lobed, fleshy or fleshy-tough in substance, with white context and spores and large, irregular tubes, which become friable or laciniate with age. They are usually found on or near dead wood in some form, either attached to buried sticks or roots or growing close to the base of a tree trunk. This latter habitat is a favorite one for at least four members of the genus, and the tree is usually an oak.

The distribution of members of this genus is quite general. Two of our species occur also in the Eastern hemisphere and two others are represented there by nearly related plants. *G. frondosa* may be said to be abundant, *G. poripes* and *G. Berkeleyi* are fairly well known and the remaining three are rare, *G. ramosissima* being more common, however, in Europe than in America.

Owing to the difficulty of handling such large forms and the changes which they undergo in drying, many mistakes are current concerning these plants. It is not easy to gain a just conception of an entire plant from one of its minute divisions, and in this, as well as in other groups, form and habit of growth count for much. If some of the existing errors have been eradicated by these studies, there is yet much to learn with regard to known species and more concerning those whose standing is still in doubt.

Synopsis of the North American species

1. Hymenium ochraceous, becoming dirty-yellow with age, plants terrestrial, irregularly confluent, olivaceous to greenish-yellow. 1. *G. poripes.*
Hymenium at first fuliginous, becoming paler. 2. *G. Sumstinei.*
Hymenium white or pallid from the first. 2.

2. Surface of pileus gray or grayish-brown to coffee-colored, stipe intricately branched, pileoli very numerous and small. 3.
Surface of pileus pallid or alutaceus, stipe not intricately branched, lobes usually few in number and comparatively large. 4.

3. Pileoli lateral, spatulate or dimidiate. 3. *G. frondosa.*
Pileoli centrally attached, circular and umbilicate. 4. *G. ramosissima.*

4. Sporophore of immense size, 20–60 cm. in diameter, spores echinulate, 8–9μ. 5. *G. Berkeleyi.*
Sporophore small for the genus, only 8 cm. or less in diameter, spores smooth, ovoid, much smaller. 6. *G. fractipes.*

1. **Grifola poripes** (Fr.)

Polyporus poripes Fr. Nov. Symb. 48. 1851.
Polyporus flavovirens B. & Rav. Grevillea, **1**: 38. 1872.

Small plants of this species from the collections of Curtis were described by Fries in 1851. Somewhat older plants were later renamed by Berkeley and Ravenel, the name referring to the very characteristic mixture of yellow and green in the plant as it develops. Most of the herbarium specimens of this species are young and do not properly show the systematic position of the plant, its relationship clearly being with *Grifola* instead of *Scutiger.* It occurs on the ground in woods, rising from a tubercle and spreading broadly in irregular lobes. The substance is eaten by insect larvae. Specimens have been examined from Massachusetts, *Blake, Ricker;* Canada, *Dearness;* New York, *Long;* Delaware, *Commons;* New Jersey, *Ellis;* Ohio, *Morgan;* Pennsylvania, *Everhart;* Virginia, *Murrill;* and Carolina, *Ravenel.* It is fairly common and always eagerly picked by collectors. A good description of it may be found in the Journal of Mycology for January, 1886. Ellis there makes some corrections in the original description of Berkeley and Ravenel.

2. **Grifola Sumstinei** sp. nov.

A very large plant resembling *G. frondosa* in habit and general appearance, but with fewer and broader pileoli, darker surface and darker hymenium. Pileus imbricate-multiplex, 20 × 30 cm., pileoli flabelliform to spatulate, 6–8 × 6–8 × 0.3–0.5 cm.; surface radiate-rugose, finely tomentose, light to dark brown; margin very thin, fissured and strongly inflexed when dry: context white, fibrous, fleshy-tough to almost leathery, 0.3 cm. thick; tubes 0.2 cm. long, 7 to a mm., at first fuliginous, becoming pallid at maturity, polygonal, irregular, edges very thin and fragile, becoming lacerate; spores globose, smooth, hyaline, thin-walled, copious, 5 μ: stipe tubercular, woody, blackish below, connate-ramose, lighter-colored, passing insensibly into the pileoli above.

This species is found about old stumps and trunks during the autumn. It has been collected three times in as many different states. Morgan determined it as *P. giganteus* Pers., a European species which it resembles in habit and coloring. His specimen from Ohio is rather small and undeveloped. A still smaller plant, only 4 cm. high, is in the Langlois collection from Louisiana. The type plants of the species, however, were sent this year to the New York Botanical Garden from Pennsylvania by Professor D. R. Sumstine. They are large and well developed and show both the immature and the mature hymenium in a highly satisfactory manner. I take pleasure in dedicating the species to Professor Sumstine.

3. GRIFOLA FRONDOSA (Dicks.) S. F. Gray

Boletus frondosus Dicks. Crypt. Brit. **1**: 18. 1785.
Polyporus frondosus Fr. Syst. **1**: 355. 1821.
Grifola frondosa S. F. Gray, Nat. Arr. Brit. Pl. **1**: 643. 1821.
Polypilus frondosus Karst. Rev. Myc. **3**: 17. 1881.

This species is commonly found at the base of oak trees. It is very large, intricately branched, fleshy to tough, and usually grayish in color. It varies considerably and has several names. The European and American forms do not appear to differ very much, and I have also been unable to distinguish it in herbarium material from such species as *P. intybaceus* and *P. anax*, the shape of the spores being rather variable and uncertain in this group. Quite a full description of the present species is given in the Journal of Mycology for January, 1886. Exsiccati are very abundant. Most European collectors have distributed it and it has been reported from nearly every state in this country, *e. g.*, Iowa, *Macbride*, *Fitzpatrick;* Ohio, *Morgan*, *Lloyd;* District of Columbia, *James;* Pennsylvania, *Everhart;* Louisiana, *Langlois;* Canada, *Dearness*. Atkinson, in his Studies of American Fungi, discusses the species at length and gives two illustrations of it from original photographs.

4. **Grifola ramosissima** (Scop.)

Boletus ramosissimus Scop. Carn. ed. 2. **2**: 470. 1772. — Schaeff. Fung. *pl. 111.* 1763.

Boletus umbellatus Pers. Syn. 519. 1801.
Polyporus umbellatus Fr. Syst. **1**: 354. 1821.
Cladomeris umbellata Quél. Enchiridion, 167. 1886.
Cladomeris ramosissima Murrill, Jour. Myc. **9**: 95. 1903.

This species closely resembles *G. frondosa* in size, habit and general structure, but the pileoli are centrally attached and circular in form instead of dimidiate and spatulate. It is likewise much rarer than *G. frondosa* both in this country and in Europe. Persoon's name seems a very appropriate one, but it is antedated by that of Scopoli. Quélet used this species in establishing his genus *Cladomeris*, a synonym of *Grifola*. In America, the plant is reported but rarely. Atkinson found it at Ithaca and refers to it in his Studies of American Fungi. Specimens are at hand from Pennsylvania, *Everhart;* Connecticut, *Underwood & Earle;* and Ohio, *Lloyd;* the last accompanied by a fine protogravure of the entire living plant.

5. **Grifola Berkeleyi** (Fr.)

Polyporus Berkeleyi Fr. Nov. Symb. 56. 1851.
Polyporus subgiganteus Berk. & Curt. Grevillea, **1**: 49. 1872.
Polyporus Beatici Peck, Rept. N. Y. State Mus. Nat. Hist. **30**: 36. 1878.

This species was described from a single pileolus sent to Fries from Curtis' North Carolina collections. It fully warrants the expression used by Fries in describing it: "Nobilissimus inter omnes mihi cognitos Polyporos." I have seen plants two feet in width and over a foot high, with several lobes six to nine inches in diameter. They usually grow under oak trees, often between the enlarged bases of the main roots, and are in close connection with some supply of humus, either from buried wood or very rich leaf-mould. The surface of the pileus is light yellowish-brown, darker toward the center, the tubes irregular, light yellowish-brown, fragile and somewhat toothed. It is easily distinguished from its American allies by the size, color and breadth of its lobes. *Polyporus Beatici* Peck and *Polyporus subgiganteus* B. & C. are not specifically distinct. The former was collected in Maryland and well described in manuscript by Miss Banning; the latter is represented at Kew by a single pileolus collected by Wright in Connecticut.

Specimens are at hand from Massachusetts, *Banker;* Canada, *Dearness;* Missouri, *Demetrio;* Ohio, *James, Lloyd;* West Virginia, *Nuttall;* Pennsylvania, *Everhart;* New York, *Banker;* Virginia, *Murrill.* Lloyd's photogravures 23 and 24 exhibit the appearance and habit of the living plant most accurately and beautifully. It seems fitting that this magnificent plant should be so well represented. It is also appropriate that it should bear the name of a man who has done so much for American mycology.

6. **Grifola fractipes** (B. & C.)

Polyporus fractipes B. & C. Grevillea, **1**: 38. 1872.

Little is known of this species beyond the collections of Curtis and Ravenel in South Carolina and an occasional plant reported from adjoining states. The specimens at hand are better developed than those at Kew, with older and larger pores, and show a close relationship rather with species of *Grifola* than *Polyporus.* Although the stipe is not branched in these specimens, it is distorted and tubercular at the base as though united with other pilei that were as yet immature. So far as the general structure of context and hymenium goes the species exhibits very close similarity with typical *Grifola* forms.

SPECIES INQUIRENDAE

Polyporus anax Berk. Grevillea, **12**: 37. 1883. Described from Ohio. Apparently not specificially distinct from *G. frondosa.*

Polyporus lactifluus Peck, Bull. Torrey Club, **8**: 51. 1881. Described from dried material and notes sent by Miss Banning from Maryland. It seems different from *G. Berkeleyi* only in having milky juice, a character possessed by other members of this genus and probably present in *G. Berkeleyi* in its young stages.

Romellia gen. nov.

Hymenophore large, irregular, annual, spongy to corky, epixylous; stipe simple, variously attached, surface of pileus anoderm, hispid; context ferruginous, tubes irregular, thin-walled, spores ellipsoidal, smooth, hyaline, cystidia none.

The type of this genus is *Boletus sistotremoides* Alb. & Schw., better known as *Polyporus Schweinitzii* Fr. The plant is a large and striking one, quite common in Europe and America, and has figured under several genera since it was first described as a *Boletus.* Soon after being transferred to *Polyporus*, it was assigned to *Daedalea* because of its irregular pores, then to *Polystictus* because it seemed nearly allied to *P. perennis.* Quélet, however, overlooked this relationship and classified it under *Cladomeris* with *Polyporus frondosus*, *P. imberbis*, etc., largely on account of its hyaline spores. The species may be easily confused in some of its forms with *Polyporus hispidus*, but its normal form is stipitate, while *P. hispidus* is always dimidiate and the spores of the former are hyaline while those of the latter are of a deep golden hue. From the genus *Coltricia*, apparently its nearest ally, it differs in having hyaline spores, a more spongy context, differently colored tubes and a very variable stipe.

I take pleasure in dedicating this genus to my friend Lars Romell, the distinguished mycologist of Stockholm, Sweden.

Romellia sistotremoides (Alb. & Schw.)

Boletus sistotremoides Alb. & Schw. Conspec. Fung. 243. 1805.
Polyporus Schweinitzii Fr. Syst. Myc. **1**: 351. 1821. Icon. *pl. 179. f. 3.* 1870.
Daedalea epigaea Lenz, Schwäm. 62. 1831.
Polyporus tabulaeformis Berk. Lond. Jour. Bot. **4**: 302. 1845.
Polyporus spectabilis Fr. Nov. Symb. 48. 1851.
Polyporus hispidioides Peck, Rept. N. Y. State Mus. Nat. Hist. **33**: 21. 1880.
Polystictus Schweinitzii Karst. Rev. Myc. **3**: 18. 1881.
Cladomeris Schweinitzii Quél. Enchiridion, 169. 1886.

The description of this fungus as given by the original authors is sufficiently clear and complete and the plant is so well known as to require little comment upon its appearance and structure. On account of its exceeding variability, well-known mycologists, such as Fries, Berkeley and Peck, have been led to rename it in certain of its forms. *P. tabulaeformis*, for example, is an old plant of *P. Schweinitzii* from Augusta, Georgia, sent to Berkeley by Wray, while a similar specimen sent by Curtis from North Carolina to Fries received the name *P. spectabilis*, the type of which still exists at Upsala. Fries was deceived by the firm, corky substance and very changed aspect of the plant in its older stages.

Peck was led to separate the rather rare dimidiate form of this species found on the trunks of trees under the name *P. hispidioides*, because of its resemblance to *P. hispidus*.

All of these forms and others which have received no distinct names seem to grade imperceptibly into one another, so that their separation would seem impossible even if desirable. The plant is an illustration of one of those unsettled types found more than once in this family which are blessed with overflowing exuberance of vitality and have several ways of expressing it. Thus, for example, while it usually attacks coniferous trees it may also be found on deciduous wood; while occurring commonly on the roots or at the base of its host, it may ascend to a height of fifty feet on the trunk, and while usually central-stemmed, the stipe may be lateral or even wanting. It is a very fine, large, highly-colored plant, well-known for its destructive effects upon coniferous trees both in Europe and America. Specimens nearly two feet in diameter were collected the past summer on the roots of larch trees at Mendel Pass in the Italian Tyrol.

According to Schrenk, who has studied the species in New England, the fruit bodies appear in July and August and are greedily devoured by beetles soon after the spores are matured. During the discharge of the spores, drops of a yellow liquid were collected by him from the hymenium, which were found to contain certain fungous sugars. It is probable that these sugars have something to do with the distribution of the spores among the roots of new host plants.

Some of the localities where this widely distributed fungus has been collected are given below. It is not rare in Asia and Europe and seems even more abundant in North America: Finland, *Karsten;* England, *Plowright;* Tyrol, *Bresadola & Murrill;* Newfoundland, *Waghorne;* Canada, *Macoun;* Vermont, *Burt;* Connecticut, *White;* New York, *Earle, Peck;* New Jersey, *Ellis;* Delaware, *Commons;* Oregon, *Carpenter;* Washington, *Macbride;* South Carolina, *Shear;* Louisiana, *Langlois;* Alabama, *Earle & Baker;* Mexico, *Smith.*

COLTRICIA S. F. Gray, Nat. Arr. Brit. Pl. **1**: 644. 1821.

Strilia S. F. Gray, Nat. Arr. Brit. Pl. **1**: 645. 1821.
Polystictus Fr. Nov. Symb. 70. 1851.

Pelloporus Quél. Enchiridion, 166. 1886.
Mucronoporus Ell. & Ever. Jour. Myc. 5: 28. *pl. 8.* 1889.
Onnia Karst. Finlands Basidsv. 326. 1889.
Xanthochrous Pat. Cat. Tun. 51. 1897.

The genus *Coltricia* was established by S. F. Gray in 1821 upon three species, *C. connata*, *C. nummularia* and *C. leptocephala*. The first, which is considered the type of the genus, is the *Boletus perennis* of Linnaeus, a well-known plant of wide distribution, placed under the genus *Polystictus* in Saccardo's Sylloge. The other two are typical species of the genus *Polyporus* in the narrowest sense. Gray placed them in *Coltricia* because they had the "stem central, cap orbicular, umbilicate, membranaceous," while important differences in structure were disregarded. The genus *Strilia*, based on *S. cinnamomea* (Jacq.), has no claim to distinction and was evidently erected through error or lack of proper material.

The genus *Polystictus*, separated as an experiment by Fries in 1851, is based on *Polystictus parvulus*, a close ally of *P. perennis*, and must therefore stand as a synonym of *Coltricia*.

The genus *Pelloporus* included *P. perennis*, *P. tomentosus* and other allied species with corky or coriaceous context, ferruginous substance and spores and terrestrial habits. The first species listed is *P. triqueter*, a wood-loving form of *P. circinatus*, in which the stipe has become lateral and rudimentary. In a former article (Jour. Myc. 8: 95. 1903), *P. triqueter* was considered more nearly related to *P. radiatus*, which also has a spiny hymenium and grows on tree-trunks, and the genus *Pelloporus* was there treated as a synonym of *Inonotus* Karst. Since the proper position of *P. triqueter* is determined *Pelloporus* must now be considered synonymous with *Coltricia*.

The genus *Mucronoporus* was based on *M. circinatus*, *M. dualis*, *M. tomentosus* and nine other species quite different in structure from the three mentioned, but resembling them in having a spiny hymenium, which was the distinguishing feature of the genus. In observing this feature exclusively, a number of other species, as varied an assortment as the family affords, have been since added to the original twelve. The genus *Onnia*, with the same distinctive character as *Mucronoporus*, was established later in the same year upon *Onnia circinata* and *Onnia tomentosa* and is therefore a synonym of *Mucronoporus* and *Coltricia.* As to the standing of such genera as *Hymenochaete* and *Mucronoporus*, based solely on the presence of cystidia, opinion has been divided, but a brief study of various forms will show that this character is possessed exclusively by no one group of fungi and that it varies abundantly even within the limits of a single species. It often affords a convenient clue to the identification of species, but should be accompanied by stronger and more permanent characters in the separation of genera.

The species of the present genus are terrestrial or wood-loving plants found in dry soil in woods or attached to decayed sticks or roots beneath the ground or growing at times upon much-decayed logs and stumps. Some of the species have a peculiar fondness for places where fires have been built; others are able to adapt themselves to very varied localities, growing now upon rich soil and again upon dead standing tree-trunks. In appearance, they are usually circular, central-stemmed, brownish plants with rusty context and spores and a brown hymenium, which is covered with a yellowish or whitish powder when young. Cystidia are rarely present. The consistency of the pileus varies from coriaceous to spongy and the surface from concentrically zonate to smooth. As to distribution, the members of the genus are about equally divided, half of them being cosmopolitan and the other half local. The smallest plant of the group is *C. cinnamomea*, the largest *C. Memmingeri*, a new species known from one locality only.

Synopsis of the North American species

1. Pileus concentrically zonate, context thin. 2.
   Pileus azonate, context rather thick and spongy. 4.

2. Pileus shining cinnamon, strigose, striate, thin, flexible, slightly depressed, the margin often fimbriate or pseudo-ciliate. 1. *C. cinnamomea.*
   Pileus dull rusty cinnamon to hoary, velvety to glabrous, deeply depressed, the margin thicker and less fimbriate. 3.

3. Tubes small, 0.5 mm. or less in diameter. 2. *C. perennis.*
   Tubes large, 1 mm. in diameter. 3. *C. parvula*

4. Context homogeneous, hymenium free from spines. 5.
   Context duplex, soft above and woody below, hymenium beset with spines. 4. *C. tomentosa.*

5. Pileus ferruginous to fulvous, 5 cm. in diameter, surface finely tomentose, stipe swollen and soft at the base. 5. *C. obesa.*
   Pileus darker, fulvous to chocolate-colored, 10 cm. in diameter, surface rough and shaggy, stipe scutate and firm at the base. 6. *C. Memmingeri.*

1. **Coltricia cinnamomea** (Jacq.)

Boletus cinnamomeus Jacq. Collect. **1**: 116. *pl. 2.* 1786.

Strilia cinnamomea S. F. Gray, Nat. Arr. Brit. Pl. **1**: 645. 1821.

Polyporus oblectans Berk. Lond. Jour. Bot. **4**: 51. 1845.

Polyporus splendens Peck, Rept. N. Y. State Mus. Nat. Hist. **26**: 68. 1874.

Polyporus subsericeus Peck, Rept. N. Y. State Mus. Nat. Hist. **33**: 37. 1880.

Polystictus cinnamomeus (Jacq.) Sacc. Michelia, **1**: 362. 1878.—Atkinson, Stud. Amer. Fungi, 192. *f. 182.* 1900.

This species appears to be truly cosmopolitan, being found in both hemispheres in tropical as well as in temperate regions. In habitat it differs from its nearest American allies in growing more commonly on mossy soil or much-decayed wood and rather sparingly on sandy soil, thus showing a preference for almost pure humus rather than for sterile soil very poor in humus. In appearance it is small, slightly depressed, silky and shining, well deserving the name, *P. splendens*, assigned to it by Peck. Its first name, however, refers to its cinnamon color and dates back to the days of Jacquin, who received it from Westhofen in the month of September. His description plainly refers to our plant:

> "Totus cinnamomeus, etiam in substantia interna. Stipes solidus, teres, villosulus, plus minus uncialis, erectus, calamo gracilior. Pileus in centro infundibuliformis, in limbo planus, lineam unam alteramve crassus, diametri uncialis, supra sericeus nitidus et ad tactum holoserici adinstar mollis, subtus poris angulatis totus refertus. Sponte exiccatus colorem servat, nec putrefecit, fragilis dumtaxit evadit, et parumper limbo crispatur. Crescit inter muscas in humo udo."

Only two characters in this description need comment. While the species is usually slightly depressed, it is sometimes more or less infundibuliform, as our own plants show, and Jacquin seems to have got some of the latter kind. The term *fragilis* seems to have been incorrectly or rather freely used. Fries questions its correctness, while S. F. Gray stumbles over it into erecting the genus *Strilia*, which differs from *Coltricia* only in being fleshy instead of membranaceous.

P. oblectans was described from Australian material. Berkeley's description, though unusually complete, does not differ materially from that of Jacquin and the type plants cannot be distinguished from American specimens. Soon after Peck named the

American plant Cooke referred it to *P. oblectans*, while Peck soon discovered that *P. splendens* was preoccupied by a Brazilian species and changed the name to *P. subsericeus*.

The following American exsiccati are in the New York Botanical Garden herbarium: Canada, *Dearness;* Iowa, *Holway;* Maine, *White;* Connecticut, *Underwood & Earle;* New York, *Peck*, *Lobenstine*, *Earle*, *Gerard;* New Jersey, *Ellis;* Pennsylvania, *Everhart*, *Barbour;* Ohio, *Morgan;* West Virginia, *Nuttall;* Georgia, *Underwood*, *Stevenson;* Alabama, *Earle;* Colorado, *Underwood & Selby*.

2. COLTRICIA PERENNIS (L.) Murrill, Jour. Myc. 9: 91. 1903.

Boletus perennis L. Sp. Pl. 1177. 1753.—Sowerby, Eng. Fung. *pl. 192.* 1799.
Boletus coriaceus Scop. Fl. Carn. ed. 2. **2**: 465. 1772.—Bull. Herb. France, *pl. 28.* 1780.
Boletus subtomentosus Bolt. Hist. Fung. **2**: 87. *pl. 87.* 1788.
Boletus confluens Schum. Saell. **2**: 378. 1803.
Polyporus perennis Fr. Syst. Myc. **1**: 350. 1821.
Coltricia connata S. F. Gray, Nat. Arr. Brit. Pl. **1**: 644. 1821.
Polystictus perennis Karst. Rev. Myc. **3**: 18. 1881.
Pelloporus perennis Quél. Enchiridion, 166. 1886.

This species appears to be common throughout the northern hemisphere in temperate regions, occurring in woods on dry exposed soil, especially where fires have been kindled, or rarely in moss or leaves. When young, it is ferruginous-cinnamon in color with punctiform tubes and thin substance; as it grows older the pileus becomes more depressed, the tubes longer and more decurrent, the sterile marginal band disappears and the whole plant appears thicker and firmer; in age the color becomes hoary, the zones are more marked, much of the tomentum disappears and the tubes and margin become more or less fimbriate. These changes often appear very marked when collections made in autumn are placed beside those of midsummer.

The present species is at once distinguished from *C. parvula* by its much smaller tubes and from *C. cinnamomea* by its larger size, more deeply depressed center and less shining surface. Specimens have been examined for the principal herbaria and published exsiccati, among which the following will indicate the distribution of the species: Finland, *Karsten;* Sweden, *Starbäck;* Saxony, *Krieger;* Hungary, *Linhart;* Belgium, *Westendorp & Wallays;* France, *Fautrey;* England, *Massee, Plowright;* Canada, *Macoun;* Maine, *Blake, Harvey, Ricker, Macdougal;* Massachusetts, *Fursten;* Washington, *Macbride;* Wisconsin, *Calkins;* Michigan, *Minns;* Minnesota, *Holway;* New York, *Shear, Peck;* New Jersey, *Ellis.*

3. **Coltricia parvula** (Kl.)

Polyporus parvulus Kl. Linnaea, **8**: 483. 1833.
Polyporus connatus Schw. Trans. Am. Phil. Soc. **4**: 154. 1834.
Polystictus parvulus Fr. Nov. Symb. 70. 1851.
Polyporus focicola B. & C. Jour. Linn. Soc. Bot. **10**: 305. 1868.

This species was described from plants in the Hooker herbarium collected by Dr. Richardson in America. Klotsch had hardly published his description before Schweinitz described the same plant under the name *Polyporus connatus.* When Fries established the genus *Polystictus,* this species was listed first, thus becoming its nomenclatorial type. Later it was renamed *P. focicola* by Berkeley and Curtis, the reason not being assigned. The plant occurs only in North America and is confined, so far as is known, to the states south of Massachusetts. As with *C. perennis,* it usually grows on earth mixed with ashes and charcoal from fires built in woods.

There is no difficulty in distinguishing it from *C. perennis* except in middle ground occupied by both species, where they have a tendency to approach each other in varieties. There can be no doubt that the two species are intimately related in origin and the inference is that *C. parvula* is an offspring of the cosmopolitan species induced by conditions existing at one time in the more southern parts of North America. They are at present, however, so distinct that a plant collected in Georgia may with little hesitation be called *C. parvula,* while one from Canada may with equal certainty be labeled *C. perennis.* The following collections of *C. parvula* are at hand: North Carolina, *Curtis;* South Carolina, *Ravenel;* Georgia, *Harper;* Alabama, *Earle;* Delaware, *Commons;* Pennsylvania, *Everhart, Jeffries & Haines.* In every instance the collection was made on soil where fires had been built.

4. **Coltricia tomentosa** (Fr.)

Polyporus tomentosus Fr. Syst. Myc. **1**: 351. 1821.
Polyporus dualis Peck, Rept. N. Y. State Mus. Nat. Hist. **30**: 44. 1878.
Pelloporus tomentosus Quél. Enchiridion, 166. 1886.
Macronoporus tomentosus Ell. & Ever. Journ. Myc. **5**: 28. 1889.
Onnia tomentosa Karst. Finlands Basidv. 326. 1889.
Xanthochrous tomentosus Pat. Cat. Tun. 52. 1897.

This species has frequently been collected by North American mycologists, but has rarely been correctly determined by them. Some European botanists are no less confused by the two Friesian species, *P. tomentosus*, described in 1821 and *P. circinatus*, described in 1848. At Upsala there is no type specimen of the latter species, while types of *P. tomentosus* correspond in all respects with our common species, the hymenium bearing the same kind of spines and the context being dual instead of homogeneous. Indeed, I have seen nothing in any foreign herbarium to indicate that *P. circinatus* is specifically distinct from *P. tomentosus*.

This fungus usually grows on or near the ground beneath pines, spruces and other coniferous trees. Collections are at hand from Bavaria, *Allescher;* Sweden, *Romell;* Canada, *Macoun;* Maine, *Curtis;* New Hampshire, *Minns;* Vermont, *Burt;* Massachusetts, *Clarke;* Pennsylvania, *Stevenson;* New York, *Peck;* New Jersey, *Ellis;* West Virginia, *Nuttall;* Colorado, *Underwood & Selby.*

5. **Coltricia obesa** (Ell. & Ever.)

Polystictus obesus Ell. & Ever. Bull. Torrey Club, **24**: 125. 1897.

This species was collected at Newfield, New Jersey, and at Philadelphia, Pennsylvania, growing on buried pine branches. It is thick and spongy in texture, depressed, rusty cinnamon, azonate, with dark cinnamon stipe, which is central and usually much enlarged below. The spores are elliptical, ferruginous, 7–8 × 4–5 μ. No spines are present. The plant resembles *Coltricia perennis* in color, but is larger, thicker, more fragile and entirely free from zones. From *C. tomentosa*, it differs in being darker in color, homogeneous in texture and free from cystidia. Type specimens are now in the herbarium of the New York Botanical Garden.

6. **Coltricia Memmingeri** sp. nov.

A large dark brown plant with rough shaggy surface and short thick stipe much dilated at the base. Pileus very irregular, circular to dimidiate, convex to plane or depressed, 10 × 1 cm.; surface fulvous to dark seal brown, ornamented with long imbricated scales of the same color, margin alutaceous, pubescent, sterile, subacute, undulate: cortex corky, fragile, azonate, 0.5–1 cm. thick, thinner towards the margin, concolorous; tubes adnate, 1–4 mm. long, 1–3 to a mm., umbrinous, apparently blackening with age, mouths circular and whitish when young, becoming angular, irregular and concolorous or darker with age, dissepiments entire to dentate: spores ovoid, smooth, light ferruginous, usually 2-guttulate, $4 \times 7\,\mu$; hyphae golden-yellow; cystidia none; stipe central or excentric, at times confluent, very short, thick, angular or flattened, dilated at the base to twice its thickness above, resembling the pileus in color, surface and substance, 1–3 × 3–5 cm.

The above description was made from specimens collected at Blowing Rock, North Carolina, by Mr. E. R. Memminger, September 1, 1901, and sent to the Underwood herbarium. According to the accompanying field notes, it is a rare species and one of peculiar habits, being found on steep clay banks with its short stipe broadly spreading at the base, reminding one of a sea-anemone, and its pileus irregular and deformed by the steepness of its habitat and soaked with moisture from the wet clay soil and the surface water that trickles past it. In some ways it suggests forms of *P. Schweinitzii*, but differs widely in the color of its tubes and spores as well as in its shaggy surface and peculiar stipe. In many ways it forms a climax to the series which begins with *C. cinnamomea* and ends with *C. obesa*, the plants increasing in size, thickness, irregularity, variability and roughness as one proceeds.

I take pleasure in dedicating the species to its discoverer, Mr. Memminger. The type plants are now in the herbarium of the New York Botanical Garden.

SPECIES INQUIRENDÆ

Polyporus simillimus Peck, Rept. N. Y. State Mus. Nat. Hist. **32**: 34. 1879. This species was based on plants collected at Brewerton, New York, on burnt soil where *C. parvula* grew. It is said to closely resemble *C. parvula* when looked at from above, but to have much smaller tubes and slightly longer spores, which are tinged with red at times. It is also very close to old plants of *C. perennis* collected in autumn. Additional collections should decide whether it is a good species or only a variety, as it was first considered by Peck.

Coltriciella gen. nov.

Hymenophore small, annual, tough, epixylous; stipe attached to the vertex of the pileus; surface of the pileus anoderm, zonate; context spongy, fibrous, ferruginous, tubes angular, one-layered, dissepiments thin; spores ellipsoidal, smooth, ferruginous.

The type of this genus is *Polyporus dependens* B. & C., a very rare plant found thus far only on dead pine logs in South Carolina and New Jersey. In some ways it resembles the genus *Porodiscus*, the species of both being small and epixylous with vertically attached stipes, but the two genera are very distinct as regards more important characters, such as the structure of the context and spores. From *Coltricia*, its nearest ally, the present genus differs chiefly in being uniformily epixylous and in having a pendant vertically-attached pileus. The name I have chosen refers to its general resemblance to *Coltricia*, this resemblance being best seen in *Coltricia cinnamomea*, which grows very frequently on wood in a state of advanced decay. Only one species is known.

Coltriciella dependens (B. & C.)

Polyporus dependens B. & C. Ann. Nat. Hist. II. **12**: no. 44. 1853. Grevillea, **1**: 37. 1872.

Polystictus dependens Sacc. Sylloge Fung. **6**: 213. 1888.

This very rare and interesting little fungus was first collected by Curtis in South Carolina on decorticated pine wood lying on the ground. It has since been found at Newfield, New Jersey, once under a decaying oak log and twice on a dead pine. The first of these collections on pine seems to have been quite abundant, since there are still in the Ellis collection about twenty-five specimens of it. Ellis says that they grew from the upper surface of the hollow in a rotten log, where they were found on July 30, 1883. On April 21, 1890, Dr. F. W. Anderson discovered a few plants growing on a rotten pine knot near Newfield. I am inclined to think that the collection made under the dead oak log was really growing on chips or sticks of pine.

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DELTA AND DESERT VEGETATION

By DANIEL TREMBLY MAC DOUGAL

NEW YORK
1904

[Reprinted from BOTANICAL GAZETTE, 38: 44–63, July 1904]

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DELTA AND DESERT VEGETATION.

DANIEL TREMBLY MACDOUGAL.

(WITH SEVEN FIGURES)

THE systematized discussion of the deserts of North America recently attempted by Mr. Coville and the author[1] made it obvious that the southern extension of the Nevadan-Sonoran desert in Sonora and peninsular California around the head of the Gulf was practically a *terra incognita* to the naturalist.

The waters of the Gulf have been surveyed and the more prominent features of the shore lines traced, but since this work was done thirty years ago, the charts, originally made from data collected by "Commander" George Dewey in 1873–75, are sadly in need of revision, especially in the region contiguous to the mouth of the Rio Colorado. The positions of the prominent hills and mountains visible from the sea have been plotted as range marks for the navigator, but the maps bearing the results are difficult of interpretation by the explorer on land.

A fair share of attention has been paid to the animal life of the river and Gulf, but the extensive areas around the mouth of the river and the head of the Gulf have so far practically escaped investigation. These regions offer difficult problems of transportation and subsistence to the explorer. The southern part of the delta include vast areas of muddy salt flats cut by a labyrinth of shallow pools and channels, and joining directly the desert slopes and plains of Baja California and Sonora. The water in the lower course of the river is brackish for a distance of 30^{km} from the sea, while other sources of water are uncertain and widely separated, the tropical sun forming an additional factor to test the endurance of the unaccustomed traveler. In running the boundary on the long northwestward slant of the Arizona-Sonoran line after the Gadsden Purchase Treaty, the commission found it necessary to haul water nearly 200^{km} to meet the needs of its camps. The trail which runs near the boundary across a typical portion of the desert mesa was the route followed by Mexican prospectors rushing to the Californian gold fields in 1849, and in the waterless stretch of 150^{km} between Quitovaquito and Tinajas Altas may be counted over four hundred small circles and crosses of loose stones by the side of the trail, grim evidences of failures to negotiate this formidable "Jornada del Muerto."

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[1] COVILLE, F. V. and MACDOUGAL, D. T., The Desert Botanical Laboratory of the Carnegie Institution. November, 1903. Washington, D. C.

Attempts to penetrate the desert directly from the coast have met with equally serious difficulties. The shore is fringed with mud flats many kilometers in width, and numerous sand bars bare at low water; the tides rise $4–10^{m}$ and produce currents that run $4–8^{km}$ per hour, forming waves or bores that sweep up the river, at times endangering all craft not in protected anchorages. But few sheltered anchorages are to be found in the upper Gulf, and nearly all of these are far from a supply of fresh water. The few expeditions to this region in which attention was paid to the flora are easily recounted.

Colonel Andrew B. Gray traversed the desert from the international boundary to Adair Bay in 1854, discovering the singular parasitic *Ammobroma Sonorae* Torr.,[2] which fastens to the roots of Franseria and Dalea at depths of $60–120^{cm}$ in the sand, and sends its fleshy stems to the surface, on which the flowers appear to rest.

Dr. E. Palmer traveled southward from Yuma to Lerdo near the head of tidewater in 1889, and collected about two dozen species of plants,[3] but no general account of the expedition is available.

Descriptions of a number of the plants are to be found in the accounts of the boundary survey,[4] in which but little attention, however, appears to have been paid to the flora of the delta.

T. S. Brandegee[5] made a long journey overland, in the same year in which he traversed Baja California, for a distance of several hundred miles northward to San Quintin in about the same latitude as the southernmost point reached by my own expedition. However, he did not reach the country east of the main divide north of San Luis Bay, 300^{km} south of the mouth of the river.

[2] TORREY, J., Ammobroma, a new genus of plants. Ann. Lyc. Nat. Hist. N. Y. **8**: June 1864.

[3] ROSE, J. N., Contrib. U. S. Nat. Herb. **1**:27. 1890.

[4] Report on U. S. and Mex. Boundary Survey, Emory **2**:21. 1859.

[5] BRANDEGEE, T. S., A collection of plants from Baja California, 1889. Proc. Calif. Acad. II. **2**:—. 1889.

Mr. Edmund Heller made some explorations and zoological collections for the Field Columbian Museum, February–December 1902, in which the western slopes of the Santa Catalina, San Pedro Martir, or Calamuie Mountains and of the Hanson Laguna Mountains were traversed. Mr. Heller crossed the main divide in about latitude 31° 30′, south of the main elevation of Calamahuie, to Parral, which lies about 600^{m} above sea level. One degree to the northward the main range was again crossed at San Matias Pass and his expedition reached the bay of San Felipe. The account of this work contains notes on the occurrence of many important plants, including the giant cactus and the Washington palm.[6]

The author organized an expedition to this region early in the present year, under the joint auspices of the Desert Botanical Laboratory of the Carnegie Institution, and of the New York Botanical Garden. In accordance with plans made a year previously, Mr. G. Sykes, civil engineer, of Flagstaff, Arizona, proceeded to Yuma in November 1903, where the construction of a small sloop, 9^{m} in length with 2.4^{m} beam, was begun and which was brought to completion late in January 1904. This boat was of a flat-bottomed design suitable for floating down the muddy shallows of the river, and was furnished with a centerboard for use in sailing the rougher waters of the Gulf, being rigged with a mainsail and jib.

In addition to the camp equipment, which included means for storing and carrying fresh water, and a special form of portable canteen, provisions, compasses, binoculars, cameras, aneroids, thermometers, hygrometers, and other material to a total weight of about 500^{kg} was taken aboard. The party included Prof. R. H. Forbes, Director of the Agricultural Experiment Stations of Arizona, and an assistant, in addition to Mr. Sykes and the author. A general narrative in which the detailed movements of the expedition are given has already been published[7] and need not receive further attention in this article.

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[6] ELLIOT, D. G., A list of mammals collected by Edmund Heller in the San Pedro Martir and Hanson Laguna Mountains and the accompanying coast regions of Lower California. Field Columbian Museum, Publ. 79. Zoological Series **3**: no. 12. 1903.

[7] MACDOUGAL, D. T., Botanical explorations in the southwest. Jour. N. Y. Bot. Garden **5**:89. 1904.

THE DELTA.

The expedition cast loose from the shore at Yuma at noon on January 28, and within a short distance below the sand bluffs on either hand curved away from the stream, and we were fairly in the great delta which extends from this point to the Gulf of California, a distance of about 140^{km}; while the coastal plains on the western side of the Gulf embrace mud flats that constitute an actual extension of the delta 50^{km} further. This delta probably offers more varied and striking features of natural history than any other watercourse in North America. The river which has formed it rises in the perpetual snows of Utah, Wyoming, and Colorado, and runs 2500^{km}, chiefly through arid regions, before it empties into the upper end of the subtropical Gulf, into which it carries sixty million tons of sediment yearly, building up the delta and extending it seaward at a rate visible to common observation within a single lifetime.[8] Numerous witnesses among the Cocopa Indians, Mexicans, and river men are agreed that the various distinct associations of plants characterized by salt grass, willow, and poplar, have advanced about $12–14^{km}$ to the southward during the last fifty years.

The portion of the delta near the present course of the river consists of an alluvial plain, not more than 4^{m} above the low-water mark, subject to constant bank erosion, shifting, and remaking of the soil, cut in all directions by old channels existing as bayous and sloughs, and flooded at high water in May, June, and July. Almost pure formations of willow and poplar (*Populus mexicana*) cover many square kilometers and furnish food for thousands of beavers that burrow in the banks. The poplar is thickly infested with a mistletoe (Phoradendron), and fungal parasites are abundant. Large areas are occupied by the arrow-weed (*Pluchea sericea*), and mesquite (*Prosopis velutinea*), and the screw-bean or "tornilla" (*P. pubescens*). Two or three species of Atriplex are also to be found in sections in which the action of the water prevents the establishment of the woody perennials of greater size. In the upper part of the delta a cane (Phragmites) fringes the channel, and its closely interwoven roots act materially in preventing erosion of the banks.

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[8] FORBES, R. H., The Colorado river of the west. Univ. of Ariz. Monthly 6:112. 1904.

In the lower part of the delta, where the river is affected by the spring tides, the cane is partly replaced by a cat-tail "tule" (*Typha angustifolia*), which not only lines the shores for many miles, but extends back some distance on areas free from trees, forming dense masses that afford shelter for a number of animals, including a peculiar subspecies of a small mountain lion.

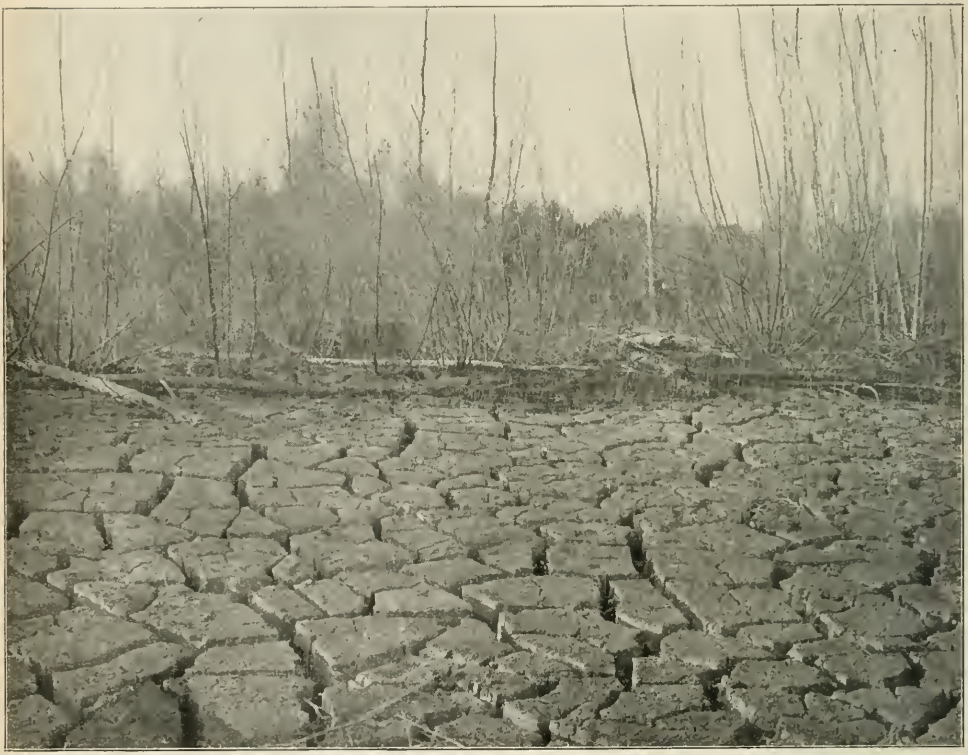

FIG. 1.—Scene on right bank of Rio Colorado, Baja California, a few meters from the margin of the stream, 10^{km} below Yuma; the conchoidal fractures of the clayey mud are $30-35^{cm}$ in depth; Salix and Populus in background; Station 1 of hygrometric observations.

Large areas throughout the delta which were not covered by trees bore wild hemp (Cassia ?) in great abundance. The slender stems reach a height of $3-4^{m}$, branch profusely above, and bear numerous pods. At the time of our visit, the plants which were annuals were dead and dry, still retaining the seed pods, and progress through one of these plantations was accompanied by a shower of seeds which results from any disturbance of the plant. The clearings also furnished suitable conditions for a plant with a deeply buried bulb, probably a Calochortus, which is eaten by the Cocopa Indians under the name of "chech," and also forms an important article of food of the sand-hill crane, and of the wild hogs that infest the tules.

The forests of willow and poplar begin to lose density at a distance of 50–60^{km} from the Gulf, the willows extending farthest toward salt water, a few being seen near the mouth of the Hardy branch of the Colorado. Beyond these are the mud plains, the portions not actually subject to erosion being thickly covered with salt grass (*Distichlis spicata*) and *Cressa truxillensis*, and bearing small clumps and isolated specimens of salt bush (Atriplex), mesquite, and screw bean. Such areas are inundated at the highest tides; consequently the soil solutions are heavily charged with salts, and whitish alkaline crusts appear during the winter dry season.

The floods of spring and early summer from the rains and melting snows of the headwaters region of the river raise the level of the water until it flushes the innumerable old channels and covers the greater part of the delta. Most of the herbaceous species make their annual growth after the waters have subsided in July. Other species, which are less affected by the lower temperatures and low relative humidity of the winter season, are set in action by the favorable conditions of March and April, and come into bloom at this time, thus making two distinct seasonal groups of annuals.

The main stream of the river cuts directly into the gravel plain or mesa of Sonora at four points on the eastern margin of the delta, and here are to be seen the striking contrasts of the isolated xerophilous plants of the dry gravelly soil of the desert within a few meters of the pure dense formations of the muddy soil of the alluvial plain of the delta (*fig. 2*). In places the creosote bush (Covillea) descends the gentler slopes to the margin of the moister soil near the margin of the channel, accomplishing a growth which carries it to a height of over 7^{m}, the maximum size for the species.

The above description applies most directly to the eastern and southern portions of the delta, which may be observed in the descent of the river, but it by no means exhausts the interesting features of the region. If the low-lying contiguous areas to the westward capable of being flooded are included, the delta may be said to have an area approximately equal to the state of Connecticut. One arm extends over 200^{km} to the northwestward and includes the Salton Basin, with its exposed bottom more than 130^{m} below the level of the sea. Although the summer floods of extreme height find their way by old channels into this basin, creating a temporary lake of great extent, yet the district affected must be classed as desert, since the highly saline character of the soil and prevailing low humidity and precipitation support representative types of vegetation (*fig. 4*).[9] Other basins ordinarily dry, with saline deposits, are to be found in various parts of the depressed area, which has the characteristics of a sea-floor of comparatively recent date.

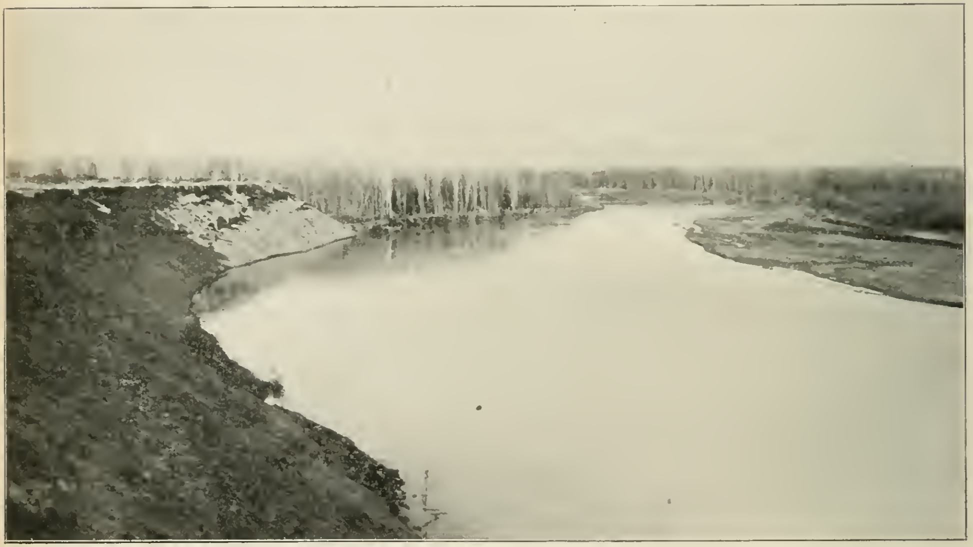

FIG. 2.—View of Rio Colorado at a point where it cuts into the desert mesa of Sonora a few kilometers south of international boundary; looking downstream; Populus and Salix on right bank; dense forest of Populus in background on left bank; portion of mesa in foreground on left bank with Covillea, Stillingia, and Ephedra; Station 3.

[9] See also COVILLE and MACDOUGAL, The Desert Botanical Laboratory of the Carnegie Institution (November 1903), pp. 21–22. *pls. 23–26.*

Many parts of the delta and of the adjoining districts in the deserts of Sonora and Baja California show traces of recent earthquakes and of volcanic action, a tract 2 by 10^{km} being now occupied by a number of active mud volcanoes.

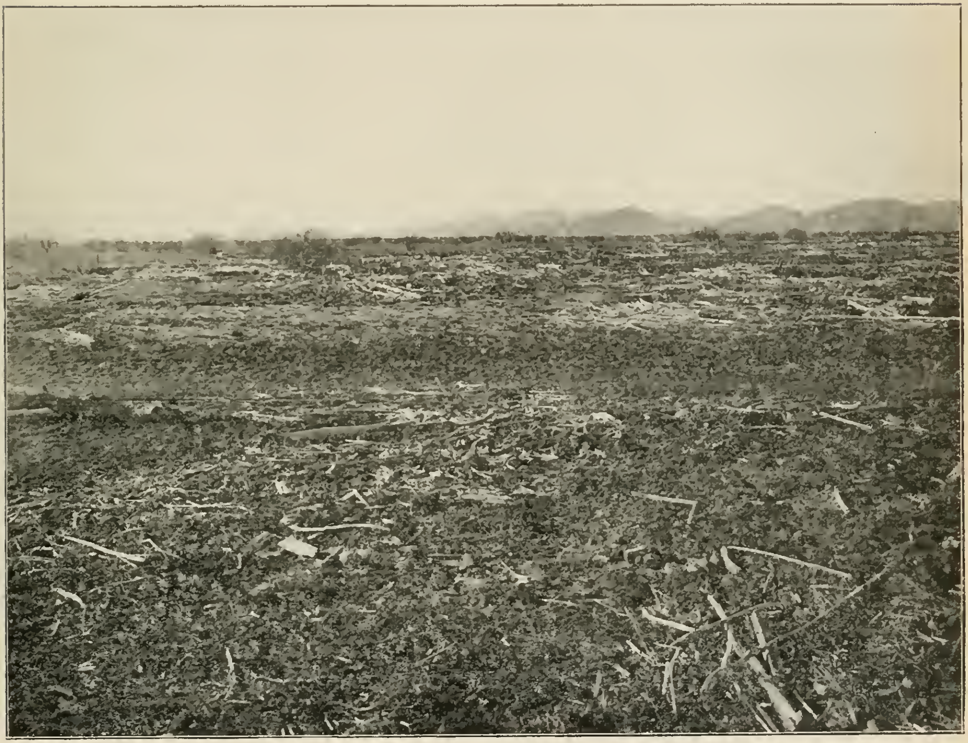

Fig. 3.—View to southward on floodplain of Rio Colorado below mouth of Hardy's branch; Range Hill in distance; carpet of *Cressa truxillensis* and *Distichlis spicata;* Prosopis scattered over plain, which also shows great quantities of driftwood.

The Cocopa Mountains rise directly from the delta to a height of over 1300^{m}, and their granite slopes support an island of desert vegetation of the types induced by low humidity and precipitation.

DESERTS.

The arid region east of the delta, extending southward from the Gila River, consists principally of long gentle slopes or sandy gravelly plains rising gradually toward the interior, and broken here and there by a succession of low mountain ranges, such as the Agua Dulce, Pinacate, and Santa Clara Mountains. The soil is particularly subject to the action of the wind, but the irregular consistency of the sand allows the formation of moving dunes or "sables" in a few localities only near the delta. Mounds of a few meters in height, held together by the roots of Ephedra, Covillea, and other shrubs, are numerous, however, such mounds being due either to the erosion of the soil around them, or to its accumulation and retention by the clumps of plants. In addition to the few herbaceous annuals which arise during the season favorable for growth, the principal types are perennials with spinose branches and reduced deciduous leaves, although a few species with hardy leaves are included. *Ephedra*, *Gaertneria albicaulis*, *Oenothera claviformis*, *Lupinus mexicana*, *Abronia villosa*, *Astragalus Vaseyi*, *Plantago scariosa*, *Langloisia Schottii*, *Stillingia annua*, *Asclepias subulata*, and *Fouquieria splendens* are typical examples; while a few forms with deeply lying bulbs are also found here, including *Hesperocallis montana* (*fig.* 5).

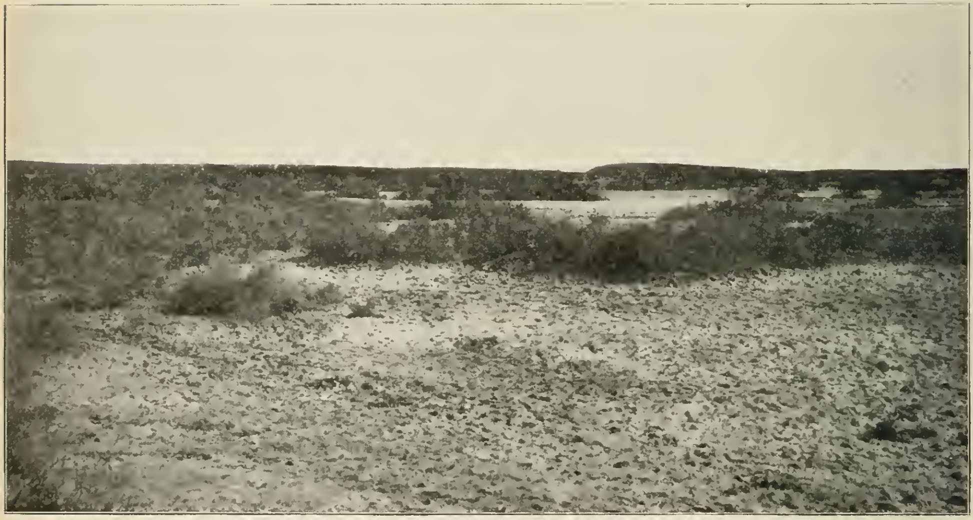

FIG. 4.—View in Salton Basin, California; the surface of the soil is thickly incrusted with saline matter in the open spaces; the vegetation consists chiefly of Spirostachys and Atriplex.

The character of the portion of the Colorado desert lying within the state of California is the subject of a recent paper by S. B. Parish,[10] and need not be discussed further here. He says, concerning the delta: "the region bordering the Colorado River is too little known to permit exact statements regarding it."

The arid region of Baja California to the eastward of the main divide covers an area of much greater topographical diversity, but with less rainfall probably than the Sonoran slopes across the Gulf, from which its flora is widely different in general composition. My examination of this part of the country was made from San Felipe Bay, which lies about 60^{km} south of the mouth of the Rio Colorado in latitude 31° N. The western shore of the Gulf between this point and the river is made up of a continuation of the mud-flats of the delta, and has great expanses covered with Cressa and salt grass.

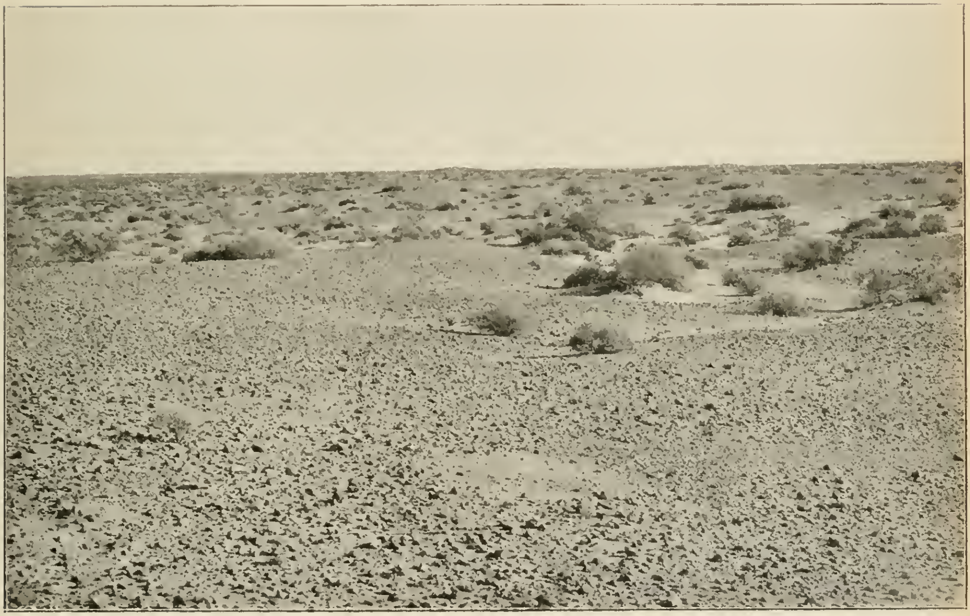
FIG. 5.—View to southeastward from Lerdo, Sonora; the gravel mesa bears scattering bushes of Covillea and Ephedra.

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[10] PARISH, S. B., A sketch of the flora of Southern California. BOT. GAZ. 36:203–222, 259–279. 1903.

The central elevation consists of the mountain ridge which culminates in the peak of Calamahuie at an elevation estimated at about 3300^{m}. To the eastward it breaks into lofty precipices and steep slopes which have not been surmounted between 30° 30′ and 32° 30′ N., no passes having been found in this wild stretch of 100^{km}. Between the main range and the coast lie numerous minor ranges disposed in labyrinthine complexity, which also have not been explored. So far as available information may be relied upon, no botanist had previously visited this region, and some care was taken to secure living and preserved specimens of the native plants whenever at all possible.

The lower coastal slopes were found to be sandy and gravelly, the depressions and near the shore furnishing suitable conditions for *Lycium Torreyi* and *Parosela spinosa*, which latter becomes a tree 7^{m} in height. *Asclepias subulata* was abundant in clumps, and *Ditaxis serrata* grew on level areas. Other species, characteristic of the lower levels, were *Ibervillea tonella*, *Croton californicum*, *Lupinus mexicanus*, and the curious *Frankenia Palmeri*. The low alkaline pockets reached by the spring tides furnished conditions suitable for *Spirostachys occidentalis*. Covillea, with its enormous capacity of adjustment, extended from near the shore across the entire slope and up the granite mountains through a range of over 600^{m} in elevation. The various portions of the slope between the sea and the first range of mountains supported ocotillo (*Fouquieria splendens*), which attained its maximum height of 10^{m}, palo verde (*Parkinsonia microphylla*), palo fierro (*Olneya tesota*), Bursera, and *Gaertneria ilicifolia*. The streamways leading down from the mountains were inhabited by a number of Eriogonums and euphorbiaceous herbs. A few Opuntias of the cylindrical arboreous type, an Echinocactus, a Mammillaria, and a small Cereus were also seen. *Pilocereus Schottii*, which is found on the mainland far southward, here reaches the greatest density yet observed, forming dense forests, acres in extent. Perhaps the most notable feature from a geographical point of view was shown by the presence of a great tree cactus, having the appearance of *Cereus pecten-aboriginis*. *Cereus Pringlei* is known to be abundant under the common name of "cardon" farther south, but this plant appears to agree with the former, and makes a splendid picture in the arid landscape, finding here its extreme northern limit of known occurrence.

The large number of species with laticiferous juices was especially noticeable, but with the exception of the dozen Cacti no plants with organs for the storage of water were seen, a fact possibly connected with the extremely low precipitation and low water content of the soil at all times. Seeds of a Cenchrus were very abundant and were used by burrowing rodents as a means of fortification of the entrances to their burrows, in the same manner that the joints of the "cholla" are employed elsewhere.

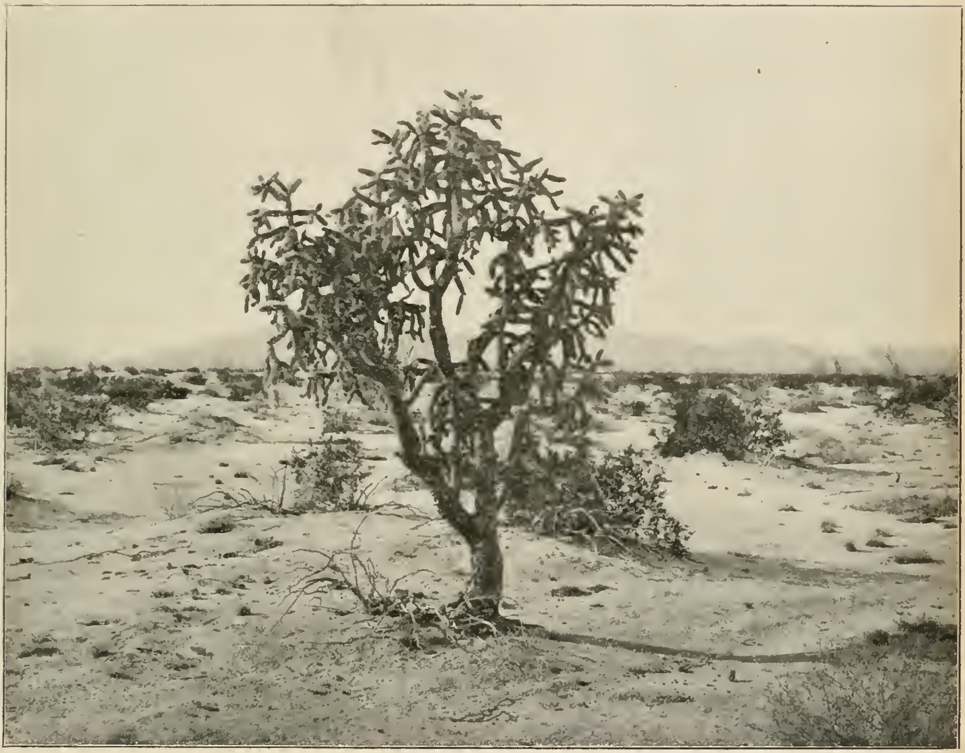

FIG. 6.—Desert of Baja California, looking westward from beach north of San Felipe Bay; Opuntia, Covillea, and Fouquiera.

A mountain to the southwestward of San Felipe Bay was climbed and a summit reached at an elevation of over 1000^{m}. The granite slopes supported a sparse vegetation of such types as Mammillaria, Ephedra, *Bursera microphylla*, *Asclepias albicans*, *Eriogonum infla-*

tum, Yucca, Agave, and Opuntia. So far as might be estimated by the instruments at hand, the mountain is probably the one on the hydrographic map of 1873–75 designated as a "sharp white peak 4288^{ft}," which had not previously been ascended, and still bears no name.

METEOROLOGICAL FEATURES.

Data bearing on the climatic conditions in the delta and of the contiguous deserts are very meager. Records have been kept at Yuma for a long term of years, and some data obtained at Torres, Sonora, quoted in the recent contribution by Mr. Coville and the author,[11] constitute the only information available. The following table taken from the records of the U. S. Weather Bureau[12] gives the conditions at the head of the delta.

The transcript of the record was furnished by Hon. Willis L. Moore Chief U. S. Weather Bureau.

1903	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total	Normal
Maximum temperature	76	82	90	97	106	112	111	113	112	96	87	80	..	..
Minimum temperature	33	29	38	47	50	60	69	72	59	51	42	34	..	..
Precipitation	..	.23	..	..	..	..	.04	..	.67	.04	..	..	.98	2.98
Average precipitation (1876–90)	.30	.45	.18	.12	.06	..	.13	.40	.13	.21	.35	.64	3.06	..

MEAN RELATIVE HUMIDITY.

8 A. M.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1903	53.5	62.9	53.3	52.0	61.3	59.9	61.1	68.3	67.4	54.3	46.7	39.5
1904	43.0	45.7	....	....	....	....	....	....	....	....	....	....

8 P. M.

1903	28.0	44.8	23.0	17.0	17.9	17.8	21.7	2.82	30.9	23.7	28.4	24.2
1904	20.7	21.7	....	....	....	....	....	....	....	....	....	....

It is to be seen that the delta and the contiguous districts have an annual precipitation of less than 7^{cm}, and that less than 2^{cm} was received during the year 1903, the relative humidity at all times being very low also. The rainfall is distributed throughout the year, so that only a small proportion of the total is received within any month; furthermore, this distribution is irregular in any series of seasons, so that the native plants have but little opportunity of acquiring a rhythm of activity in response to the annual supply of moisture, a fact not without its influence on the general anatomical character of the plants, as will be pointed out below. In no part of the country to the southward of Yuma did we find any evidences of a greater rainfall than that given above, upon noting the surface of the soil

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[11] Desert Botanical Laboratory of the Carnegie Institution, p. 23. November 1903.

[12] GREELY and GLASFORD, Report on the climate of Arizona. Ex. Doc. No. 287. Washington. 1891. Climate and Crop service, U. S. Weather Bureau. Report for Arizona Section for 1903.

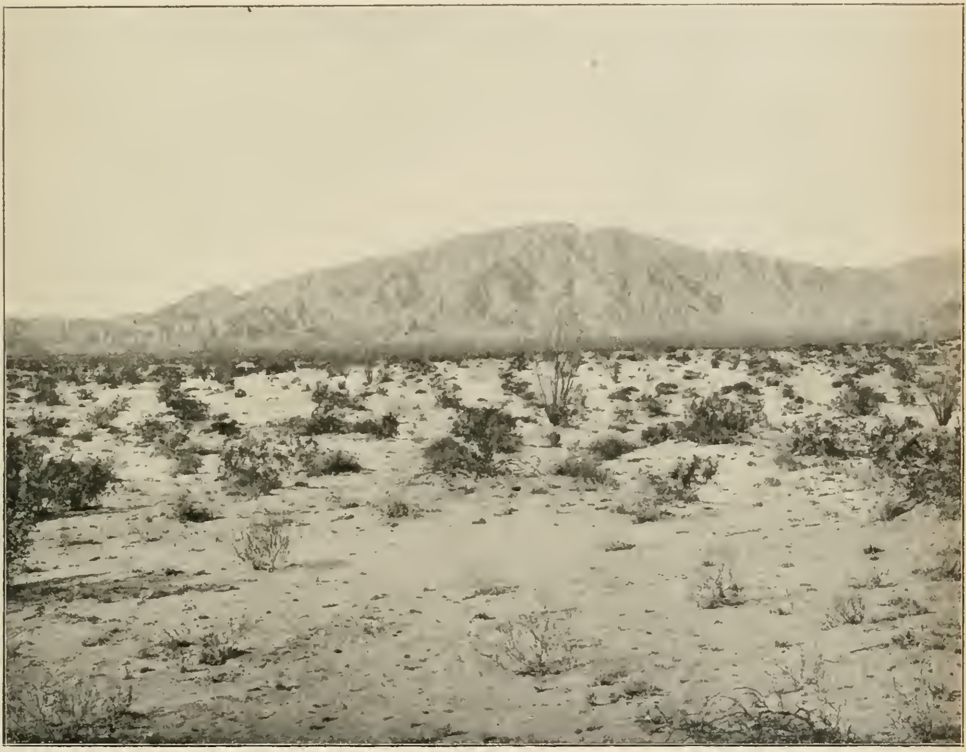

FIG. 7.—Desert of Baja California; view from San Felipe Bay; peak over 1000^m high, ascended February 14, 1904, in distance; the sloping plain which rises gradually to the foot of the mountain bears Fouquieria, Ephedra, Covillea, Bursera, Parosela, Parkinsonia, and Cereus.

and the state of resting vegetation, and no precipitation occurred during the month the expedition was actually in field. Attention is to be called to the table of relative humidity, in which it is to be seen that the minima are very low, yielding averages from 17 to 30 per cent. So far as a general inspection could be relied upon, it did not appear that precipitation had occurred at San Felipe Bay within three months, and it might well have been three times that period since any had been received.

Dr. Edward Palmer visited the Raza Islands in the lower part of the Gulf, 225^{km} northwest from Guaymas, in February 1890, and notes that no rainfall had been received there for more than a year.[13] Nothing can be hazarded as to the extent of the region with this extreme limit of aridity on the Sonoran side of the Gulf, except that it does not include the mesa at an elevation of 300^{m} at Torres, and it does not appear to include the western slope of the central range in Baja California, although no definite information is available. So far as known at the present time, therefore, this region of extreme and constant drought, constituting the most pronounced type of desert in North America, lies on the eastward or lee side of the San Pedro Martir range of Baja California, and includes areas on the Sonoran mainland, the whole being a southern extension of the Colorado desert. It is evident, however, that a further investigation of the region is necessary to determine the exact meteorological status of this area, as well as the general character, derivation and relationships of its flora. The extreme type of strict desert offered by the area in question points to the possibility of finding here the readiest solution of some of the more important problems presented by desert vegetation.

RELATIVE HUMIDITY IN DELTA AND DESERT.

The relatively brief time during which the expedition was in the field made it impossible to secure records of value as to precipitation, although it has been noted above that no rainfall occurred, except perhaps on the higher peaks of the Cocopa Mountains and of the main range in Baja California. A Lamprecht's hair hygrometer was carried, however, and observations were taken daily, the instrument being compared before being taken into the field and after its return with other instruments for standardization. The data given below are corrected results, not direct transcripts from the notebook.

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[13] Contrib. U. S. Nat. Herb. 1:79. 1890.

Station 1.

Camp on dried mud flats on shore of Rio Colorado a kilometer below international boundary in Baja California; observations taken twenty feet from margin of bank amid willows and poplars; wind blowing offshore; see *fig. 1.*

Jan. 28	4:30 P. M.	60° F.	17% rel. hum.
" 28	6:30 "	55 "	15 "
" 28	8:00 "	51 "	18 "
" 29	12:45 A. M.	32 "	41 "
" 29	1:20 "	30 "	50 "
" 29	6:00 "	29 "	66 "
" 29	6:25 "	27 "	70 "
" 29	7:00 "	38 "	60 "
" 29	7:40	Sun on instrument	36 "

Station 2.

Camp on small island in great bend 33^km^ downstream from Yuma, covered with a dense grove of Salix except at one end.

Jan. 29	4:50 P.M.	61° F.	21% rel. hum.
" 29	7:10 "	37 "	75 "
" 29	8:45 "	32 "	57 "
" 30	2:45 A. M.	30 "	84 "
" 30	5:45 "	26 "	58 "
" 30	7:50	Sun on instrument	35 "

Station 3.

Camp at lower end of high mesa bank below La Grulla, Sonora; observations taken at a point 60^{m} from margin of bank 13^{m} in height, constituting bank of river, among bushes of Covillea, Ephedra, etc. (*fig. 2*).

Jan. 30	4:40 P. M.	70° F.	19% rel hum.
" 30	4:50 "	68 "	16 "
" 30	7:00 "	54 "	15 "
" 30	8:30 "	48 "	27 "
" 31	6:30 A. M.	44 "	30 "
" 31	7:30 "	45 "	29 "

Station 4.

Noon stop made at point where the river cuts into the Sonora mesa above "Noche Buena" cut-off; observations made at a point corresponding to Station 3, with similar vegetation.

Jan. 31	1:45 P. M.	72° F.	15% rel. hum.

Station 5.

Camp on dry shore in Baja California among willows, poplar, and saltbush, with numerous beaver slides along bank.

Feb. 1	7:00 P. M.	50° F.	30% rel hum.
" 1	8:30 "	44 "	66 "
" 2	6:30 A. M.	41 "	59 "

Station 6.

Group of adobe buildings at Colonia Lerdo, on margin of gravel mesa sloping gradually to the delta, 2^{km} from stream, among mesquite, saltbush, and arrow-weed.

Feb. 3	11:40 A. M.	78° F.	16% rel hum.
" 3	1:30 P. M.	81 "	11 "
" 3	4:15 "	79 "	10.5 "

Station 7.

Camp on eastern shore of river at Colonia Lerdo, among poplar, willow, cane, and tule, 25^{m} from margin of water and 2^{m} above surface.

Feb. 5	7:25 P. M.	64° F.	38% rel. hum.
" 5	7:45 "	64 "	40 "
" 5	2:10 "	67 "	37 "

Station 8.

The data given below were obtained at a number of points on the plain and mountains, near camp on San Felipe Bay, Baja California.

Tent on beach.

Feb. 11	6:20 P. M.	52° F.	42% rel. hum.
" 11	8:20 "	49 "	39 "
" 12	5:50 A. M.	37 "	44 "
" 12	8:00 "	56 "	27 "
" 12	8:35 "	63 "	24 "

In shade of Bursera.

At 76^{m} level, 13^{km} from shore.

Feb. 13	1:00 P. M.	71° F.	40% rel. hum.
“ 13	6:15 “	57 “	41 “
“ 14	6:00 A. M.	60 “	33 “

800^{m} on mountain.

Feb. 14	8:45 A. M.	69° F.	32% rel. hum.

1200^{m} on mountain (*fig. 7*).

Feb. 14	11:00 A. M.	72° F.	32% rel. hum.

Small mountain 100^{m} high, 20^{km} north.

San Felipe, 8^{km} from coast.

Feb. 19	9:45 A. M.	72° F.	18% rel. hum.

RÉSUMÉ.

It is to be seen that the region discussed in the foregoing paper includes a subtropical delta of irregular outline and long extensions, which includes within its outermost boundaries a great alluvial plain subject to floods, bank erosion, and shifting of the soil, and also to the action of salt tidal waters; a mountain range of granite and volcanic rocks over 1000^{m} in height; a small area of active mud volcanoes; a depressed region, presumably an old sea-floor, the bottom of which is more than 100^{m} below the level of the sea; and the mud flats near the actual mouth of the river. This delta is directly in contact with the gravel and sand desert mesas of Sonora and Baja California.

The portion of the delta subject to the direct action of the floods and tides is everywhere slightly alkaline and varies but little in the general constituency of the soil, supporting a luxuriant growth of vegetation, the more important elements of which grow in pure formations of the greatest possible density. The larger woody plants of this region have their bases submerged in water at a low temperature during the summer season, during which time the crowns are exposed to low relative humidity at temperatures that may be as much as 70° F. higher than the roots. In consequence of this condition many species in the low lands have xerophilous foliage. In addition, a comparatively high concentration of soil salts must be endured during the stages of low water.

An analysis of the flora of the region shows that many of the species of the delta extend down along the coast especially in the regions with fringing mud banks derived from the river deposits. The greater part of the vegetation of the coastal slopes and plains, however, is made up of species which also extend southward along the shores of the Gulf, and are found but sparingly to the northward.

The vegetation of the Salton basin is subjected to the action of extreme aridity and also of a high concentration of soil salts, comprising types of the most pronounced character, both of halophytes and xerophytes. The elevations included in the delta are dry mountain slopes and support a desert vegetation.

The mesas adjoining the northern part of the Gulf of California appear to offer the most extreme desert conditions in North America. The rainfall at Yuma at the northern extremity of the delta was less than 25^{mm} during 1903, and years have been noted at points farther south in which no precipitation occurred. The entire normal precipitation in the desert in Baja California is probably no greater than the amount of water condensed as dew in eastern United States. The desert apparently extends to the slopes of the central elevation of the peninsula to the westward, which reaches an elevation of over 3000^{m}. This mountain wall probably acts as a barrier which shuts off moisture-laden winds from the Pacific and causes the aridity of the region. The southern and eastern limits of the extreme desert cannot be defined with the information now at hand.

The vegetation of the desert areas in the regions of greatest aridity consists chiefly of types devoid of massive storage organs, and of perennials with laticiferous sap, while a large number of forms secrete volatile oils or exude resinous gums. The determination of the causal relations of these adaptations cannot be made safely by a general interpretation of the aspects of vegetation, but it is to be seen that in a region in which surplus rainfall or ground water never occurs, storage organs would be manifestly useless, and indeed their formation impossible. Species with spinose branches and minute leaves which are quickly discarded during unfavorable periods are abundant. Several species of Ephedra with functionally useless leaves and chlorophyllose stems are included, while Lycium and Frankenia with small succulent easily detachable leaves are highly characteristic of some localities; the last-named species are about the only species offering anything of the nature of water-storage organs outside of the Cacti.[14]

The region under discussion offers matchless opportunities for comparison of the most highly developed xerophytic types of the desert with the broad-leaved forms of the delta which root in the mud. Midway between the two are the species which stand in the moist soil of the delta, and have foliage suitable to endure the extreme aridity of the air, which constantly blows from the desert over the entire delta.

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[14] MACDOUGAL, D. T., Some aspects of desert vegetation. Plant World **6**:249–257. 1903.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL
GARDEN--No. 54

CHEMICAL NOTES ON "BASTARD" LOGWOOD

BY

BENJAMIN C. GRUENBERG AND WILLIAM J. GIES

NEW YORK
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[From the BULLETIN OF THE TORREY BOTANICAL CLUB, 31: 367-377. July, 1904]

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Chemical notes on "bastard" logwood*

BENJAMIN C. GRUENBERG AND WILLIAM J. GIES

During the past few years the growers of logwood in Jamaica have been greatly disturbed by an apparent increase on their properties of an unmerchantable variety of the plant known as "bastard" logwood.† The exportation of this wood along with real logwood has served to condemn all the logwood from the districts which have shipped it.‡

"Bastard" logwood differs from the genuine varieties, from the dyer's standpoint, in yielding little or no hematoxylin, but, instead, a yellowish-green pigment which is of no value and which, when admixed with the commercial extract, reduces the characteristic tinctorial properties of the latter. Chips of the "bastard" logwood present a yellow, pale pink, white or even chocolate-colored surface instead of the dark red or deep purple, bronze-tinted color of the best Jamaican or Mexican logwoods of commerce. There appears to be considerable uncertainty, even when the trees are cut down, as to whether a tree is really a "mulatto" ("bastard") tree or not. What is known as a "mulatto" tree is frequently dark enough when first cut to lead one to believe that it is a good redwood tree, but instead of darkening with age as all the good wood does, it remains the same color or becomes lighter rather than darker. The "bastard" tree seems to be perfectly dry, and even when the chips are soaked for a long time in water, they give out no dye.*

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* From the New York Botanical Garden, New York. Some of the chemical work was done in the laboratory of physiological chemistry of Columbia University.

† Fawcett: Bulletin of the Botanical Department, Jamaica, 3: 179. 1896.

‡ Clipping from a Kingston, Jamaica, newspaper, sent to Dr. D. T. MacDougal by Hon. William Fawcett (September, 1901).

Various theories have been advanced to explain the apparent increase in the "bastard" logwood in Jamaica. Professor F. S. Earle, after a thorough study of the situation in Jamaica, came to the following conclusions : †

1. "Logwood is a variable plant showing marked differences in form, color and texture of leaf; time of blooming; form and extent of ribs on the trunk; color of bark and especially in the color and dye-producing quality of the heart-wood. Four well-marked varieties are said to be recognized in Honduras and three are usually recognized in Jamaica, but there are many other intermediate forms."

2. "Bastard" wood is not the result of disease or of any lack of vigor. The trees producing it are perfectly healthy and normal.

3. "It is not the result of soil or climatic conditions, since 'bastard' and normal trees are found growing side by side under absolutely identical conditions."

4. "It is not the result of immaturity. Aged trees may produce 'bastard' wood, while in normal trees the heart-wood, as soon as formed, contains a good percentage of hematoxylin. These facts seem to point to heredity as the probable cause of the trouble. That is, that certain trees produce only 'bastard' wood because they grow from the seed of a 'bastard' tree; or in other words that 'bastard' logwood represents a variety of *Haematoxylon campechianum* that normally produces little or no hematoxylin, just as one Honduras variety has smaller, shorter, thinner and lighter colored leaves."

Some time before Professor Earle made his investigations in Jamaica we began, at Dr. MacDougal's suggestion, a comparative study of logwoods from that island, in the hope of finding definite chemical differences, other than purely tinctorial ones, between "red logwood" and the "bastard" variety. Unfortunately our work in collaboration was soon unavoidably interrupted. We present here very briefly, however, such of our notes in this connection as may be of general interest.

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* Cradwick : Report to the Chairman of the Experiment Station, Kingston, Jamaica, 1902 (April 4).

† Earle : Journal of the New York Botanical Garden, 4 : 3. 1903.

ELEMENTARY COMPOSITION OF HEART-WOOD. — Elementary analysis of typical samples of (1) the red logwood of commerce, (2) a "bastard" variety somewhat resembling it and (3) a second specimen of the "bastard" type yielding hardly any pigment to water gave the following results:

TABLE I.

PERCENTAGE ELEMENTARY COMPOSITION OF SUBSTANCE DRIED TO CONSTANT WEIGHT AT 110°C.*

	I.			II.			III.		
	"Red" Logwood.			"Bastard" (medium grade).			"Bastard" (poorest quality).		
	C†	H	Ash.	C†	H	Ash.	C†	H	Ash.
1	51.91	5.98	1.80	51.45	5.83	1.59	51.04	5.67	2.03
2	52.00	5.80	2.06	51.77	6.03	1.68	51.35	5.74	1.86
3	52.12	5.76	1.71	51.45	6.03	—	51.00	5.58	—
Av.	52.01	5.84	1.86	51.56	5.96	1.63	51.13	5.66	1.94

SUMMARY OF AVERAGES.

	I.	II.	III.	General Average.
Carbon,	52.01	51.56	51.13	51.57
Hydrogen,	5.84	5.96	5.66	5.82
Ash,	1.86	1.63	1.94	1.81
Oxygen.‡	42.15	42.48	43.21	42.61

The most significant feature of these results is the decreasing amount of carbon in the "bastard" wood. The differences are too slight to warrant any emphasis, but are such as might be due to a lower percentage of hematoxylin, which is a pigment of high carbon (and low oxygen) content — $C_{16}H_{14}O_6$.

The data of the second series of analyses, given in TABLE II, show that the wood was not decomposed in the process of drying to constant weight at 110° C. (first series) and that, therefore, the previous results were not influenced by that procedure.

GENERAL COMPOSITION OF SEEDLINGS. — In TABLE III we present the results of some analyses of seedlings of "red" logwood

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*Only heart-wood was employed in this work. This was converted into sawdust and only such portions as passed through a very fine sieve were taken for analysis. The methods of analysis were those which are now in general use.

†The figures for carbon and hydrogen are calculated (from the data of direct analysis), for *ash-free* substance.

‡Calculated, by difference, for *ash-free* substance.

TABLE II.

PERCENTAGE ELEMENTARY COMPOSITION OF SUBSTANCE DRIED TO CONSTANT WEIGHT AT 20 C.°

	I.			II.		
	C	H	H_2O	C	H	H_2O
1	46.90	5.40	7.95	46.58	5.28	7.97
2	46.98	5.24	—	46.87	5.45	—
3	47.08	5.20	—	46.58	5.45	—
Average.	46.99	5.28	7.95	46.68	5.39	7.97

and of the "bastard" variety. The condition of the seedlings at the time of analysis is shown in FIGURE 1. The outward appearance of the two kinds of seedlings was practically the same. Likewise, the differences among the figures in our table for general chemical composition are too slight to warrant any other conclusion than that the seedling metabolism was, in general, essentially the same in both varieties. The analyses were made 12 months after seeds were planted.

TABLE III.

GENERAL COMPOSITION OF LOGWOOD SEEDLINGS.*

		Water.		Solids					
				Total.		Organic.		Inorganic	
		Red.	Bastard.	Red.	Bastard.	Red.	Bastard.	Red.	Bastard
Leaves,	*a*	60.33	60.05	39.67	39.95	37.08	36.93	2.59	3.02
		59.89	——	40.11	——	37.70	——	2.41	——
	b	56.27	51.22	43.73	48.78	41.08	45.94	2.65	2.84
	c	63.57	60.68	36.43	39.32	34.72	36.50	1.71	2.82
Upper stem,	*a*	43.77	38.34	56.23	61.66	54.40	58.29	1.83	3.37
	b	39.06	34.01	60.94	65.99	59.08	63.99	1.86	2.00
	c	43.68	45.89	56.32	54.11	54.61	52.50	1.71	1.61
Lower stem,	*a*	43.19	39.99	56.81	60.01	55.62	58.32	1.19	1.69
	b	36.83	32.97	63.17	67.03	61.63	65.24	1.54	1.79
	c	43.39	44.46	56.61	55.54	55.41	54.14	1.20	1.40
Roots,	*a*	67.93	61.66	32.07	38.34	30.52	35.39	1.55	2.95
	b	65.32	70.58	34.68	29.42	33.20	27.70	1.48	1.72
	c	——	49.17	——	50.83	——	46.87	——	3.96

---

* Analyses were made by the usual drying and incineration methods. The portions subjected to comparative analysis were approximately of the same morphological location in each variety. The most significant differences seem to be the slightly larger proportion of water in the "red" wood and the relatively greater quantity of solids, especially inorganic matter, in the "bastard" samples.

CONCLUSIONS FROM THE GENERAL ANALYTIC DATA. — All of the preceding analytic results make it evident that the chemical differences existing among these logwoods are quantitatively very slight. They also make it appear probable that the variations in the different samples of the wood are chiefly variations in the chemical characteristics of the pigments themselves, which, as is well known, possess as a rule high tinctorial qualities even when they occur in only very small amounts. Our results in this connection would also indicate that there are no striking structural differences among these varieties of logwood. They suggest, likewise, that even

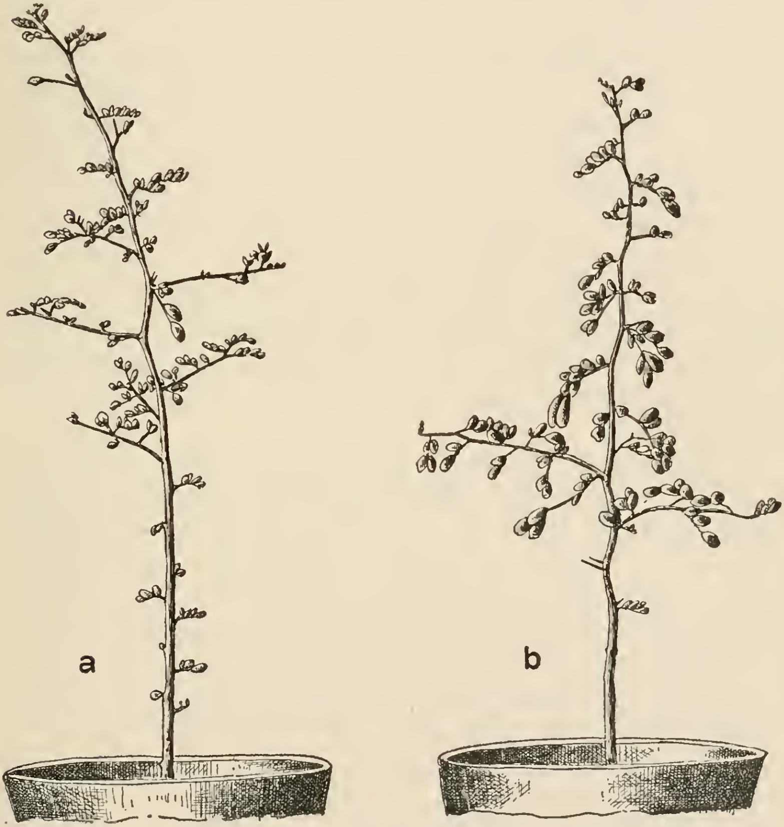

FIGURE I. Seedlings of logwood, one year old. a, "red logwood." b, "bastard logwood." Both grown from seeds obtained from "Old Hope" plantation, Jamaica.

metabolic tendencies in these logwoods are essentially the same, varying only, perhaps, in the course of events which involve relatively slight quantities of pigment.*

TINCTORIAL DIFFERENCES. — The foregoing results having shown that the differences among these logwoods were chiefly if not solely tinctorial, we next endeavored to ascertain the extent of the pigmentary variations.

Our first experiments in this connection were efforts to determine the relative tinctorial intensity of extracts of different samples of heart-wood sawdust made with equal volumes of various solvents under similar conditions of temperature, shaking, etc., from the same quantities of material dried to constant weight at 110° C.† Among the samples were several inferior qualities of red wood from dead and decaying trees.

TABLE IV gives our first results in this connection. The figures in that table denote the relative positions in a series of ten extracts — 1 indicating weakest coloration, 2 the pigmentation of next higher intensity and so on to 10 showing the most decided tinctorial effect.

The shade of color varied with each extractant, as would be expected. The following observations were made in this connection, on the color of the series of extracts referred to in TABLE IV.

I. Water—slight yellowish-brown to deep reddish-brown.‡
II. 0.2 per cent. HCl—faint yellow to orange.
III. 2.0 per cent. HCl—faint yellow through reddish-brown to bright red.
IV. 0.01 per cent. KOH — chocolate coloration throughout.
V. 0.15 per cent. KOH — deep chocolate coloration throughout.
VI. 0.5 per cent. Na_2CO_3 — chocolate coloration throughout; less than in V, greater than in IV.
VII. Saturated borax solution — faint yellow to deep reddish-yellow.
VIII. Ether — faint yellow to orange.
IX. Absolute alcohol — faint yellow to red.
X. Acetone — faint yellow through greenish-yellow to yellowish-red.
XI. Acetic ether — faint yellow to deep reddish-yellow; brighter than in VII.

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* These conclusions are in harmony with those drawn from other standpoints by Professor Earle (quoted on page 368). They were arrived at independently by us and were included in our report, in December, 1902, to the Botanical Society of America, before we were aware of Professor Earle's deductions. Science, II. 17: 338. 1903.

† Drying occurred rapidly and seemed to have no transforming effect on the dust. This fact was noted before in another connection (page 369).

‡ The coloration intensities are indicated progressively from 1 to 10 (see TABLE IV). Individual exceptions are not referred to.

XII. Chloroform — no color in some, faint yellow in others.
XIII. Benzol — no color in any.

TABLE IV.

RELATIVE PIGMENTATION OF VARIOUS KINDS OF LOGWOOD.

Extractant.	*A*	*B*	*C*	*D**	*E*	*F*	*G*	*H*	*I*	*J*
I. Water.	1	2	3	10	4	6	7	5	8	9
II. 0.2 % HCl.	1	2	5	7	6	3	4	10	9	8
III. 2.0 % HCl.	1	2	4	3	5	6	7	8	9	10
IV. 0.01 % KOH.	1	2	4	3	5	6	7	8	9	10
V. 0.15 % KOH.	2	4	1	3	5	7	6	8	9	10
VI. 0.5 % Na_2CO_3.	2	3	1	6	4	5	7	8	9	10
VIII. Ether.	1	2	5	4	8	7	9	6	3	10
IX. Absolute alcohol.	1	2	4	3	6	5	9	7	8	10
X. Acetone.	1	2	4	3	5	9	6	7	10	8
XI. Acetic ether.	1	2	3	4	6	7	5	9	8	10
Average.	1.2	2.3	3.4	4.6	5.4	6.1	6.7	7.6	8.2	9.5

A—"Bastard" (very poor). *B*—"Bastard" (very poor). *C*—Immature wood of varying tints. *D*—"Purple" (from tree on extremely poor marly bank; tree mature, but dead in nearly all parts, including the roots). *E*—Immature wood of varying tints. *F*—"Bastard" (medium grade). *G*—Red (tap root of nearly dead tree). *H*—Red (tree over ripe; wood bored by ants). *I*—Red (from roots of dead tree). *J*—Red (best grade).

More important, however, than the variations in the shades of color in the extracts was the fact, already noted, that the *sequence* of coloration intensity (in extracts made under like conditions in detail in each series) *varied* with each solvent (TABLE IV). This result not only shows that the colors of the woods are not due merely to different amounts of the same pigment but also proves that the pigmentary differences are caused either by varying proportions of at least two pigments, or by the same pigment radical in more than one chemical condition — in combinations, it may be of different solubilities and stoichiometric relationships, and of different dissociable tendencies.

Relative tinctorial differences and variations are further shown in the following sample data, which indicate the quantity of water in c.c. added to 10 c.c. of 0.5 % Na_2CO_3 extract (TABLE IV) in order to make the tinctorial intensity approximately the same throughout the series.†

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* This sample contained several pigments. One of these was purplish and quite unlike any in the other samples. The pigment was especially soluble in water. It was not ordinary hematoxylin.

† Dilution of D with an equal volume of water furnished the basis of coloration for the comparative observations.

TABLE V.

Sample of Logwood.	Water Added.	Sample of Logwood.	Water Added.
A	3.5 c.c.	C	7.5 c.c.
B	3.5	D*	10.0
F	5.5	H	10.9
E	7.1	I	12.2
G	7.1	J	17.8

The letters correspond to those in TABLE IV.

The tinctorial sequence after the above dilution is different from what it was before dilution as may be seen from the following summary: †

TABLE VI.

	1	2	3	4	5	6	7	8	9	10
Before dilution (TABLE IV).	C	A	B	E	F	D	G	H	I	J
After dilution (TABLE V).	A	B	F	E	G	C	D	H	I	J

The above facts are in further harmony with the foregoing conclusions regarding cause of coloration effects and relative differences.

Dilute aqueous extracts of two samples of red logwood and of one medium grade "bastard" wood all showed a similar yellow color, by transmitted light. The shades of color did not differ noticeably except in degree. In stronger extracts of equal concentration the first two appeared more reddish.

Treatment with alkalies, volatile and non-volatile, turned the color of the red logwood extracts to a blood-red, passing into purple, whereas in the "bastard" extract the shade of yellow was merely deepened, passing into the dull brown color of faded oak leaves. Dilute and concentrated mineral acids turned the yellow of the dilute aqueous extracts of the red wood into a color ranging from orange to bright red. In the "bastard" extract no such change was perceptible.

These differences in the behavior of the two sets of aqueous extracts toward acids and alkalies correspond to the differences between the reactions exhibited toward the same reagents by a freshly prepared solution of the commercial "extract of logwood," and a solution four weeks old that had faded to a straw-yellow.

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*This color was of the same intensity as the rest, but not the same shade. See footnote, page 373.

† A similar change in sequence of tinctorial intensity after dilution was noted in other extracts, also.

The chemical alterations undergone by the aqueous solution of the commercial extract are accompanied by such a decided change in color and in chemical properties that from a comparative study of such extracts we expected to learn something definite regarding the actual differences between the pigments in the heart-wood of "red" logwood and in that of the bastard variety. We were unable, however, to do so.

Experiments were started to determine, if possible, the relations of light and of air to the discoloration of solutions of logwood extracts. In a few weeks all the preparations had been attacked by growths of *Penicillium*, *Rhizopus* and other fungi. After filtration the solutions showed no appreciable differences in shade or color. But on diluting these filtered solutions with two parts of water and eventually with eight parts, differences were readily observed.

The solutions which had been in the light showed no change in color, whereas those kept in the dark had become distinctly yellow. The extracts to which the air had free access manifested the greatest changes.

SOLID MATTER IN LOGWOOD EXTRACTS. — We desired to ascertain, in comparative determinations, the quantities of solid matter in aqueous extracts of the various logwoods under investigation. The absolute amount of solid substance in 100 c.c. of the extract was always small — less than 0.02 gram. In the drying process slight decomposition seemed to result and perfectly constant weights could be obtained only after a long time. Although the absolute changes in weight were only very small, the proportionate variations in quantities so slight were quite large. For these reasons no comparative observations were attempted in this connection. The use of very large volumes of extract, to reduce the comparative effects of the variations referred to, was impracticable.

The general question of the physiology or chemistry of pigment-formation in the heart-wood was not approached at all, nor were the histological characters of the varieties compared.

There can be no doubt that "bastard" logwood is, as Prof. Earle also concludes (see page 368) a distinct variety or subspecies of *Haematoxylon campechianum*, notwithstanding the slight morphological differences that distinguish it from the "red logwood" and "blue logwood." The differences in the floral organs between

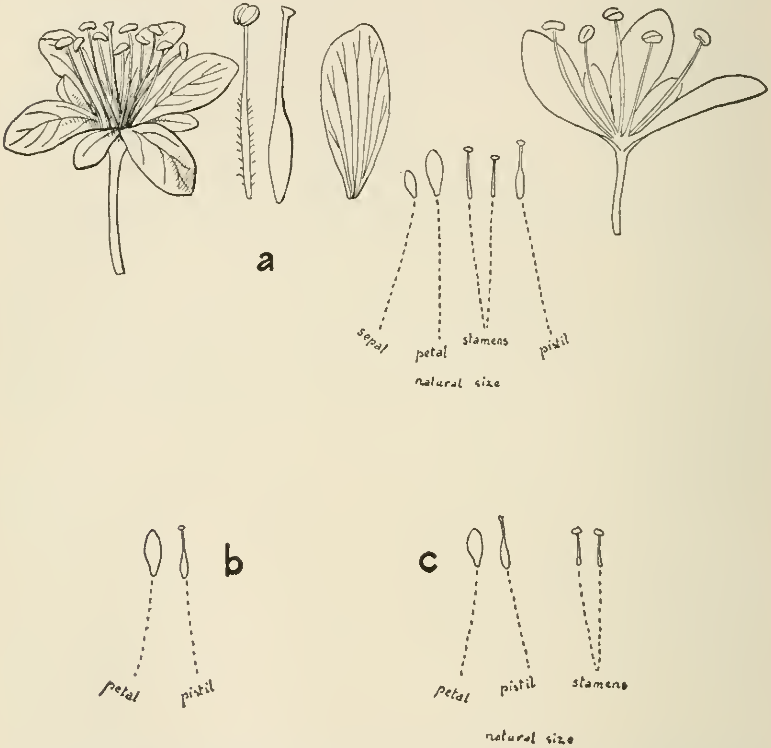

FIGURE 2. These drawings, which were made from specimens collected by Hon. William Fawcett near Morant Bay, Jamaica, show all the morphological differences that have been observed in the flowers of three varieties: *a*, "blue logwood." *b*, "red logwood." *c*, "bastard logwood."

The petals are widest in the blue and narrowest in the bastard.

The pistil of the blue is thicker than that in the red and the bastard. The style in the bastard is slightly curved.

In the bastard the stamens are smaller than in the others, and there is less difference between them.

It does not appear from the data at hand that the differences noted exceed the ordinary individual variations for the species of *Haematoxylon*.

the three varieties are shown in FIGURE 2, which was made from drawings sent by Mr. Fawcett, of the Jamaica Botanical Gardens.

That there are species which are not at all distinguishable from one another externally, but which vary in their physiological properties, is a recognized fact,* and the "bastard" logwood may simply be a new example of the same phenomenon. A parallel case would seem to be furnished by the black locust (*Robinia pseudacacia*), the wood of which is described by Sargent † as being "reddish, greenish-yellow or white, *according to locality*"; but the yellow and white varieties occur side by side in at least one locality.

SUMMARY.

1. The most significant fact shown by elementary analysis of the heartwood of typical specimens of logwood was the lower carbon content of the poorer wood, which may be due to lower pigment content, hematoxylin being a compound containing nearly twice as much carbon as oxygen.

2. No morphological differences are discernible between red logwood and bastard logwood in the young seedlings.

3. Analyses of the various seedlings agreed too closely to warrant any conclusion but that the metabolism of the seedlings was essentially alike in the two varieties.

4. The chemical differences between red logwood and "bastard" logwood are very slight, and are probably due to differences in amount of pigment.

5. Extractions with various solvents gave solutions of different colors, and also of varying orders of intensity in the several series, indicating the presence of at least two pigments in varying proportions, or a pigment radical in different combinations.

6. This was confirmed by the fact that the order of coloration intensity of a series of extracts was altered by diluting with water.

7. Aqueous extracts of the two varieties of logwood gave different reactions to acids, alkalies and other reagents. The differences are parallel to those between a fresh aqueous solution of commercial logwood "extract," and the same solution after it had become discolored on long standing.

8. Attempts to determine the conditions of the discolorations of solutions of commercial "extract," failed to yield definite results, but indicated, in general, that darkness and air are favorable to the change.

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* DeVries: Mutationstheorie, 1: 122. 1901.

† Sargent: Catalogue of the forest trees of North America, 15. Washington, 1880.

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CONTRIBUTIONS FROM THE NEW YORK BOTANICAL
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STUDIES ON THE ROCKY MOUNTAIN FLORA—XI

By PER AXEL RYDBERG

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[From the BULLETIN OF THE TORREY BOTANICAL CLUB, **31**: 399-410. July, 1904]

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Studies on the Rocky Mountain flora — XI.

PER AXEL RYDBERG

Juncus balticus vallicola var. nov.

Stem from a horizontal rootstock, rather stout, 6–8 dm. high, terete, 2–4 mm. in diameter ; sheaths at the base short, dark brown, bladeless ; bract 1–2 dm. long ; bractlets broadly ovate, scarious, brown, abruptly acuminate ; inflorescence open ; its branches 4–8 cm. long ; sepals narrowly lanceolate, slightly if at all scarious on the margin, attenuate at the apex, about 6 mm. long ; petals much broader and shorter with broad scarious margin, about 5 mm. long ; anthers about 4 times as long as the filaments ; capsules short ovoid, obtusish and mucronate, shorter than the petals.

This variety has the open inflorescence and general habit of var. *litoralis* but the fruit of var. *montanus.* It differs from both, however, in the long-attenuate sepals. It grows in wet ground, both in alkaline and sandy or gravelly soil in the valleys of the Rocky Mountain region.

WYOMING : Point of Rocks, 1901, *E. D. Merrill & E. N. Wilcox, 664* (type)* ; Big Sandy River, *730 ;* Steamboat Mountain, 1900, *Aven Nelson, 7075.*

COLORADO : Mancos, 1898, *Baker, Earle & Tracy, 438.*

UTAH : Antilope Island, *Stansbury.*

Juncus truncatus sp. nov.

J. alpinus insignis Coult. Man. 358 (in part as to the Colorado specimens). 1885.

Stems slender, 3–5 dm. high, terete or slightly flattened ; leaves 1–3 dm. long, slightly flattened laterally or nearly terete, 1–2 mm. in diameter, septate ; sheaths with scarious margins which end in rounded auricles, which are 1–1.5 mm. wide ; bract 1–3 cm. long, lanceolate or subulate, brown with green back ; inflorescence open, 2–5 cm. long, irregularly cymose with 4–10 heads ; bractlets ovate, brown, acuminate-cuspidate ; heads 6–9 mm. in diameter, 5–10-flowered ; petals and sepals lanceolate, dark brown, about 3 mm. long, acuminate, longer than the capsule which at maturity is truncate or slightly emarginate at the apex : seeds not caudate.

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* Unless otherwise stated the types are preserved in the herbarium of the New York Botanical Garden.

This species is most nearly related to *J. nevadensis*, *J. Mertensianus* and *J. Richardsonianus*, with which three it has been confused. It differs from the first in the truncate capsule, from the second in the paniculate inflorescence and not caudate seeds, and from the last in the dark acuminate petals and sepals and the short capsule. It grows in wet meadows at an altitude of 1800–2700 m.

COLORADO: Meadow Height, 1898, *Shear & Bessey, 4323* (type); Elk River, Routt County, 1894, *C. S. Crandall.*

WYOMING: Copperton, 1901, *F. Tweedy, 4335;* North Fork of Clear Creek, Big Horn Mountains, 1898, *T. A. Williams;* Grand Encampment Creek, 1897, *Aven Nelson, 3981.*

Juncus brunnescens sp. nov.

Juncus xiphioides montanus Engelm. Trans. Acad. Sci. St. Louis, **2**: 481 (in part). 1868.

Stem 4–6 dm. high, flattened laterally and more or less winged; leaves 1–2.5 dm. long, 2–5 mm. wide, equitant, laterally flattened, long-attenuate, septate; sheaths with scarious margins, abruptly contracted above, but scarcely auricled; bract linear-lanceolate, 2–5 cm. long, green; panicle open, 5–10 cm. long, with from 10–60 small heads; bractlets ovate-lanceolate or ovate, abruptly acuminate, scarious and light brown; heads 5–12-flowered; petals and sepals subequal, lanceolate, acuminate, about 3 mm. long, light brown with green midrib; stamens usually 6, sometimes 4 or 5; style about equaling the petals; capsule lance-ovoid acute.

This was included in *J. xiphioides montanus* by Engelmann, but the first specimen cited by him belongs to a distinct plant with few, large, dark brown heads. This has received the name *J. saximontanus* by Aven Nelson. Besides the character mentioned, the scarious margins of the leaf-sheaths in the latter nearly always end in small auricles, a character by which it differs from all the species of the group. *J. brunnescens* grows in wet places in the mountains of Colorado, New Mexico and Arizona, while *J. saximontanus* ranges from Alberta and British Columbia to Colorado and California.

COLORADO: Pagosa Springs, 1899, *C. F. Baker, 245* (type).

NEW MEXICO: Bear Mountain and Mangus Springs, *Rusby, 417 C, 417 D* and *417 F.*

ARIZONA: Flagstaff, 1898, *MacDougal, 304;* San Pedro Valley, *J. W. Toumey, 6;* Fort Verde, *E. A. Mearns;* San Francisco Mountains and Clifton, *Rusby, 417 A* and *417 E.*

Juncus parous sp. nov.

Stem 3–6 dm. high, laterally flattened and distinctly winged; leaves equitant, laterally flattened, septate, 2–3 dm. long, 3–5 mm. wide; sheaths with scarious margins that taper upwards and without any indication of an auricle; bracts 1–2 cm. long, green with more or less scarious margins; heads few, 1–8, often clustered, 15–20-flowered; bractlets lanceolate, light brown; petals and sepals lanceolate, sharply acuminate, subequal, light brown or greenish on the back; stamens usually 6; style shorter than the petals; capsule oblong, acute, shorter than the petals; seeds apiculate.

This is still more closely related to *J. saximontanus* than the former, but is easily distinguished by the light-colored heads and the total lack of auricles. It grows in mountain meadows of Colorado and New Mexico.

COLORADO: Fort Garland, 1896, *C. L. Shear, 3666* (type) and *3668;* North Cheyenne Cañon, 1896, and Pike's Peak, 1895, *E. A. Bessey.*

NEW MEXICO: Organ Mountains, 1897, *E. O. Wooton, 615.*

Juncoides subcapitatum sp. nov.

Stem 3–4 dm. high, glabrous; leaf-blades lanceolate, acuminate, glabrous, 4–10 cm. long, 5–10 mm. wide; bracts 2.5–3 cm. long, lanceolate, foliaceous; inflorescence compact, consisting of 6–10 heads, conglomerate and forming an irregular head; bractlets ovate, those subtending the individual flowers about half as long as the sepals; these and the petals subequal, 1.5–2 mm. long, ovate, acuminate, dark brown but lighter on the midrib; capsule broadly obovoid, obtuse, shorter than the petals; seeds about 1 mm. long, ellipsoid, obtuse, dark brown, minutely punctate.

Notwithstanding the capitate inflorescence, the large foliaceous bracts, and the shorter capsule, it is most closely related to *J. parviflorum,* which it resembles in leaves and flowers. The type grew near timber-line on a mountain above Silver Plume.

COLORADO: Silver Plume, 1895, *C. L. Shear, 4611.*

Allium macropetalum sp. nov.

Bulb obovoid, about 4 cm. long and 2 cm. thick, coated with long loose fibers; leaves about 2 cm. long, almost equaling the scapes, 2–4 mm. wide; sheaths very broad, loose and scarious; scapes a little over 2 dm. high, stout, 3–4 mm. thick, often 2 or 3 from the same set of sheaths: umbel many-flowered; bracts usually 3, ovate-lanceolate, acuminate, about 2 cm. long, veined with purple; pedicels stout, about 2 cm. long; the outer in fruit spreading or reflexed; petals and sepals lanceolate, long-attenuate, fully 1 cm. long, white, scarious, with a prominent purple midvein: capsule 5–6 mm. long, with 6 conspicuous oblong crests which are over 1.5 mm. high.

This species is perhaps most nearly related to *A. Geyeri*, but stouter, usually with 2 or 3 scapes, loose sheaths, longer and more attenuate petals and sepals, larger conspicuous crests, and longer bulb with very fibrous coat.

COLORADO: May 14, 1898, *C. S. Crandall.*

Allium Pikeanum sp. nov.

Bulb obliquely ovoid, about 1.5 cm. long and 8–10 cm. thick; coat membranous except the outer layer, which is fibrous-reticulated; scape 8–15 cm. long, almost equaled by the narrowly linear leaves: bracts usually 3, lanceolate, 8–10 mm. long and very soon reflexed; umbels with 10–15 flowers, but no bulblets; pedicels about 1 cm. long; petals and sepals subequal, ovate, acuminate, red-purple; filaments subulate, dilated below, about three-fourths as long as the petals; capsule slightly crested above.

This is most nearly related to *A. reticulatum* and *A. Geyeri*, but distinguished by the small reflexed bracts, the dark flowers and the small bulb with only the outermost layers of the coat fibrous. It grows in the higher mountains of the Pike's Peak region at an altitude of 3,000–3,800 m., while the other species mentioned belong to the plains.

COLORADO: Halfway House, 1896, *C. L. Shear, 3721* (type); South of Pike's Peak and Bald Mountain, 1895 and 1896, *E. A. Bessey;* Peak Valley, 1901, *Clements, 426.*

Corallorrhiza ochroleuca sp. nov.

Whole plant light yellow; stem 2–4 dm. high, not bulbous-thickened at the base; sheaths loose and rounded and mucronate at the apex; raceme 10–15-flowered; flowers 15–20 mm. long, light yellow, unspotted; petals and sepals 7–8 mm. long, oblong-lanceolate, acute, with prominent midvein; lip ovate, sinuate but neither lobed nor toothed; spur small and adnate to the ovary.

In general habit, this resembles a large *C. multiflora*, but differs in the yellow color of the plant, the unspotted flowers and the entire lip. It grows at an altitude of 1400–2500 m.

NEBRASKA: War Bonnet Cañon, 1890, *T. A. Williams, 48* (type).

COLORADO: Echo Cañon, near La Veta, 1900, *F. K. Vreeland, 649.*

Salix pachnophora sp. nov.

A shrub 2–3 m. high or perhaps sometimes higher: stems yellowish; branches dark bluish with a bloom; leaves oblong-lanceolate or oblanceolate, 3–5 cm. long, or on vigorous shoots 1 dm. long, acute at both ends, densely white-silky beneath, glabrous or when young slightly silky above, rather thin, with prominent veins beneath; pistillate aments subsessile, 1–3 cm. long; bracts almost black, ovate or oblong, acutish or obtuse; pistils subsessile; ovary grayish-silky, ovoid, 3–5 mm. long; styles slender, about 1.5 mm. long; stigmas slender, deeply 2-cleft; staminate aments about 1.5 mm. long, subsessile; bracts similar; stamens 2, filaments glabrous, distinct.

This species is evidently most nearly related to *S. bella* and *S. subcoerula*, differing from the former in the smaller aments and capsules and the presence of bloom on the branches and from the latter by the sessile and naked aments. It grows in the mountains at an altitude of 2,300 to 2,500 m.

COLORADO: Chambers lake, 1899, *Agricultural College of Colorado* coll. (type); Rico, Dolores Co., 1899, *Geo. E. Osterhout, 2505;* along Uncompahgre River near Ouray, 1901, *Underwood & Selby, 256.*

NEW MEXICO: Beulah, 1901 & 1902, *T. D. A. Cockerell.*

Atriplex oblanceolata sp. nov.

Suffruticose dioecious perennial with decumbent base and ascending branches, about 2 dm. high; leaves oblanceolate or spatulate, 2–3 cm. long, obtuse or acutish, densely white-scurfy on both sides, entire, short petioled, or sometimes nearly sessile; pistillate flowers in small axillary clusters; fruiting bracts ovate in outline, slightly dentate, tubercled or irregularly crested on the back; staminate flowers brown in small terminal panicles.

This species is most nearly related to *A. Nuttallii* and *A. eremicola.* From the former it differs in the decumbent low habit, the more distinctly petioled leaves and the brown panicled staminate flowers (in *A. Nuttallii* they are yellow and arranged in interrupted spikes). It is more like *A. eremicola*, from which it scarcely differs except in the tubercled or appendaged bracts, which are broadest below instead of above the middle.

COLORADO: Delta, Sept. 3, 1897, *J. H. Cowen* (Agric. Coll. Colo., *no. 4071*) (type), Hotchkiss and Smiths Fork (*no. 4070*).

WYOMING: Gardiner River, 1899, *Aven & Elias Nelson, 5995;* Hams Fork, 1900, *C. C. Curtis;* Fort Steele, 1901, *Tweedy, 4501.*

Atriplex odontoptera sp. nov.

A shrubby dioecious perennial: stems with shining white more or less flaky bark; leaves narrowly oblanceolate, acute or obtusish, 2–4 cm. long, entire, white-scurfy on both sides; pistillate flowers axillary; fruiting bracts united to near the apex; united portion with 4 laciniate dentate wings, 3–4 mm. broad, reticulate and ribbed; free portion subulate, scarcely as long as the width of the wing; staminate plant unknown.

This species is most nearly related to *A. canescens*, differing mainly in the laciniate-toothed wings. It grows on plains at an altitude of 1,000–1,600 m.

WYOMING: Buffalo, 1900, *F. Tweedy, 3302* (type); four miles below U. L. Ranch, 1896, *Knowlton, 160;* Steamboat Lake, 1900, *Osterhout, 2330*, in part.

Coriospermum emarginatum sp. nov.

Annual, perfectly glabrous or with a few hairs on the bracts, branched near the base, 3–4 dm. high: leaves narrowly linear, 2–4 cm. long, 1–2 mm. wide, cuspidate-pointed; bracts except the lowest ovate, 5–7 mm. long, acuminate, scarious-margined, much broader than the fruit; fruit plano-convex, 2.5–3 mm. long and about 2 mm. wide, almost without a trace of a wing-margin.

In habit this species resembles mostly *C. marginale*, but differs in the lack of the wing-margins of the fruit characteristic of that species. In this respect it more resembles *C. villosum*, but is a much more slender plant and glabrous.

WYOMING: Laramie, 1897, *A. Nelson, 4282* (type).

COLORADO: A specimen in the Torrey herbarium without any other data.

Claytonia rosea sp. nov.

Scape about 1 dm. high, slender, from a small corm 10–15 mm. in diameter; basal leaves rare, long-petioled; blade 1–2 cm. long, spatulate; stem-leaves linear or narrowly linear-lanceolate, sessile, 2–5 cm. long, 1-ribbed or faintly 3-ribbed, acute, rather fleshy;

sepals rounded ovate, rounded at the apex, about 5 mm. long, half as long as the pink obovate petals; inflorescence 5–10-flowered, short, little exceeding the leaves, bractlets lanceolate; capsule shorter than the sepals; seeds about 2 mm. long, black and very glossy.

The few specimens of this species that are found in our herbaria bear a variety of names, as *C. caroliniana*, *C. caroliniana lanceolata*, *C. caroliniana sessilifolia* and *C. lanceolata sessilifolia*. The original *C. lanceolata* Pursh is a much larger plant with broad, strongly 3-ribbed stem-leaves, elongated inflorescence and large flowers, the sepals being about 6 mm. long. The type of *C. caroliniana sessilifolia* Torr., is a plant somewhat resembling the present species, but with somewhat broader leaves abruptly contracted at the sessile base and with acutish sepals. Neither in the herbarium of the New York Botanical Garden nor in that of Columbia University is found any other specimen matching the original collected by Bigelow. Most species of *Claytonia* are found near water or in damp places. The type of *C. rosea* was collected on rather dry hills, at an altitude of 2200–2300 m.

COLORADO: La Veta, 1900, *Rydberg & Vreeland, 6300* (type); "Colorado," *G. C. Woolson;* 1875, *W. A. Henry;* Graham's Peak, 1899, *C. F. Baker, 305.*

WYOMING: Pole Creek, 1894, *Aven Nelson, 27.*

Cerastium pulchellum sp. nov.

Low decumbent perennial with horizontal cespitose rootstock: stems 5–10 cm. long, finely viscid pubescent; leaves oblong to oval, obtuse or rarely acutish, about 1 cm. long and 4 mm. wide, subsessile and slightly connate at the base, viscid pubescent on both sides; peduncles 1–1.5 cm. long; inner sepals oblong; outer oval, scarious-margined both on the side and at the rounded apex, about 4 mm. long; petals obcordate, 10–12 mm. long.

This species is nearest related to *C. Earlei* and *C. behringianum*. From the former it differs in the low habit, the very obtuse scarious-tipped sepals and the short blunt leaves; from the latter in the large petals and the scarious-tipped sepals. It grows in the mountains at an altitude of about 3900 m.

COLORADO: Hayden Peak, 1898, *Baker, Earle & Tracy, 573.*

Arenaria polycaulos sp. nov.

Arenaria saxosa Coult. Man. 35, 1885, and Gray, Syn. Fl. **1**[1]: 240, in part; not A. Gray, Pl. Wright. **2**: 18.

Perennial with a long tap-root, giving rise to numerous prostrate or spreading stems about 1 dm. long, slender, finely scabrous puberulent; leaves ovate or ovate lanceolate, spreading, about 5 mm. long, finely puberulent; pedicels 5–10 mm. long; sepals ovate-lanceolate, short-acuminate, scarious-margined, 3–4 mm. long; petals 5–6 mm. long, obovate, entire.

This plant has generally been known as *A. saxosa*, but the type collected by Wright differs considerably from it, being subligneous at the base, with short erect stems, lanceolate almost erect leaves and narrower sepals. *A. polycaulos* grows on dry hills at an altitude of 2600–3000 m.

COLORADO: Silverton, 1898 (type; collector not given, but specimens received from the Agricultural College of Colorado); 1895, *Tweedy, 173;* Mt. Harvard, 1896, *F. E. Clements, 54;* Gray Back Mining Camps, 1900, *Rydberg & Vreeland, 6288;* La Plata P. O., 1898, *Baker, Earle & Tracy, 444;* Dark Cañon, 1901, *Clements, 115;* Breckenridge, 1896, *Shear, 4558* and *4545.*

ARIZONA: Mt. Humphrey, 1883, *Rusby, 531;* 1897, *R. E. Kunzé;* San Francisco Mts., 1892, *Toumey, 487.*

Arenaria Tweedyi sp. nov.

Perennial, densely cespitose with somewhat ligneous base; leaves fleshy, linear-filiform, 2–3 cm. long, less than 1 mm. wide, somewhat curved; stem usually less than 1 dm. high, glandular puberulent especially on the inflorescence; this an open cyme; bracts lanceolate, scarious-margined; pedicels about 1 cm. long; sepals lanceolate, acute, about 5 mm. long, scarious-margined and decidedly glandular puberulent; petals about 8 mm. long.

This is most nearly related to *A. uintahensis* A. Nelson, differing in the fleshy not pungent leaves and the more glandular puberulent inflorescence. It grows in the mountains at an altitude of about 3600 m.

COLORADO: La Plata Mountains, 1896, *Frank Tweedy.*

Arenaria Eastwoodiae sp. nov.

Perennial with a cespitose base; stems about 2 dm. high, perfectly glabrous; leaves filiform, stiff, pungent, 1–2 cm. long, 0.5 mm. wide, minutely scabrous-ciliolate on the margin below, dilated and somewhat connate at the base; inflorescence elongated; bracts subulate to lanceolate, scarious-margined; pedicels erect, 1–2 cm. long, glabrous; sepals linear-lanceolate, about 6 mm. long, glabrous, long-attenuate, equalling or slightly exceeding the petals.

This is most nearly related to *A. Fendleri* but is more slender and glabrous. It grows on dry hills.

COLORADO: Grand Junction, 1892, *Alice Eastwood.*

Arenaria Fendleri Porteri var. nov.

Like the type but low, 1–2 dm. high, very glandular; leaves short; branches of the inflorescence short and ascending.

It is common on dry mountain ridges of Colorado. As type I take the following:

COLORADO: Gray's Peak, 1878, *M. E. Jones, 716* (type in herb. Columbia University).

Alsinopsis macrantha sp. nov.

Perennial, cespitose, diffusely branched and spreading, perfectly glabrous; branches 1 dm. long or less; leaves subulate-filiform, obtuse, 5–10 mm. long, 0.5 mm. wide, 1-nerved; pedicels 1 cm. or less long; sepals lanceolate, 4–5 mm. long, very acute, scarious-margined, strongly 3-nerved; petals oblong, 7–8 mm. long.

The type sheet is labelled *Arenaria verna* L., which it resembles much in habit, in the sepals and in the lack of pubescence, but it differs in the large petals and the 1-nerved leaves.

COLORADO: Little Kate Basin, La Plata Mts., 1898, *Baker, Earle & Tracy, 678.*

Silene Antirrhina vaccarifolia var. nov.

Stem-leaves broad, lanceolate, elliptic or oblanceolate; stem stouter than in *S. Antirrhina* proper; bracts more or less scarious-margined below; flowers and capsule larger.

In the Rocky Mountain region the typical *S. Antirrhina* is rather rare and evidently an introduced plant found in waste places and fields. It is there represented by two native forms, the present with broad leaves and large flowers and the next with narrow leaves and small flowers.

IDAHO: Lewiston, 1896, *A. A. & E. Gertrude Heller, 3153* (type in herb. Columbia University); Upper Ferry, Clearwater River, 1892, *Sandberg, MacDougal & Heller, 190.*

MONTANA: Big Horn River, 1891, *Tweedy*.

COLORADO: Foothills, Larimer County, 1895, *J. H. Cowen, 82*; near Golden, 1878, *M. E. Jones, 279*; Rist Cañon, 1897, *J. H. Cowen*.

Silene Antirrhina depauperata var. nov.

Like the species but more slender and few-flowered; calyx in fruit very short; petals none or small, not exceeding the calyx-lobes; blade cuneate, truncate or emarginate at the apex.

BRITISH COLUMBIA: Lower Arrow Lake, 1890, *J. M. Macoun* (type).

COLORADO: 1874, *G. C. Woolson*.

ARIZONA: Tucson, 1894, *J. W. Toumey*.

SOUTH DAKOTA: Lead City, 1892, *P. A. Rydberg, 557*.

WASHINGTON: W. Klickitat County, 1891, *W. N. Suksdorf*.

WYOMING: Hartville, 1892, *Aven Nelson, 493*.

NEBRASKA: Dismal River, 1893, *P. A. Rydberg, 1349*.

UTAH: City Creek Cañon, 1880, *M. E. Jones, 1839*.

Lychnis striata sp. nov.

Perennial with more or less cespitose base; stems 3–5 dm. high, finely puberulent and more or less viscid above; basal leaves and lower stem-leaves narrowly oblanceolate, 5–15 cm. long with a more or less distinct petiole; upper stem-leaves sessile and linear-lanceolate; inflorescence narrow with erect branches; calyx densely viscid puberulent, strongly 10-nerved, in fruit somewhat extended by the capsule, 10–12 mm. long and 5 mm. wide; its lobes oblong, obtuse, somewhat scarious-margined; petals exserted, about 15 mm. long; claw long, narrowly cuneate, fully equaling the calyx; blade short, two-cleft, with obtuse lobes.

This species is most nearly related to *L. Drummondii*, but differs in the exserted petals and the more strongly 10-nerved calyx. It grows at an altitude of 2000–3300 m.

COLORADO: Cameron Pass, 1896, *C. F. Baker* (type), also 1899; Silver Plume, 1895, *P. A. Rydberg*.

WYOMING: Battle, 1901, *Tweedy, 4535*, also Headwaters of Tongue River, 1898, *163*; Yellowstone Lake, 1899, *Aven & Elias Nelson, 6634*.

UTAH: Evanston, 1869, *S. Watson, 154*.

Atragene pseudo-alpina diversiloba var. nov.

A peculiar form with merely ternate leaves, the segments of which are more or less cleft or lobed, some rounded at the apex; staminodia conspicuous, spatulate or oblanceolate.

This may be a distinct species, but the material is too scant. The most striking character is the conspicuous staminodia, which in the species are narrowly linear or more often lacking.

Colorado: Mountains near Denver, 1869, *B. H. Smith* (type herb. Columbia University).

Stanleya glauca sp. nov.

Tall, perfectly glabrous, 4–6 dm. high, bluish green; lower leaves 1–1.5 dm. long, more or less pinnatifid with linear-lanceolate or oblong lobes, the terminal usually much longer than the rest; upper leaves usually entire, linear-lanceolate; racemes 3–4 dm. long, sometimes branched below; sepals and petals lemon-yellow; the former oblong, about 1 cm. long, deciduous; petals of about the same length, long-clawed; claws more or less pubescent, about twice as long as the oblong blades; fruiting pedicels about 1 cm. long, more or less spreading; stipes about 1.5 cm., slender; pod proper about 5 cm. long and 1.5 mm. thick, somewhat arcuate, but neither tortuose nor torulose; seeds oblong, dark brown, minutely pitted.

This species is perhaps most nearly related to *S. integrifolia* James, which, however, differs in the following respects: the stem lower, leaves thicker and broader, oval or broadly oblanceolate; the lower, if lobed, with broad and short lobes; claws of the petals broader at the base, shorter, scarcely longer than the oblong spatulate blades. *S. glauca* grows on the dry hills and table lands at an altitude of 1,200–2,500 m.

Colorado: Prairie, Entrance Soldier's Cañon to Sulphur Springs, 1895, *J. H. Cowen* (type); McElma Cañon, 1901, *F. K. Vreeland, 871;* plains near Fort Collins, 1896, *C. S. Crandall;* near Badita, 1900, *Rydberg & Vreeland, 6120;* Dixon Cañon, 1899, *W. F. M.;* Mancos, 1898, *Baker, Earle & Tracy, 412;* Pueblo, *10;* Garden of the Gods, 1894, *E. A. Bessey;* Pike's Peak, 1894, *T. F. Allen.*

Schoenocrambe decumbens sp. nov.

Stem slender, decumbent, 2–3 dm. long, as well as the whole plant perfectly glabrous, more or less branched; leaves narrowly linear, 2–6 cm. long, 1–3 mm. wide, 1-nerved, rather thick and more or less glaucous; raceme rather few-flowered, lax; pedicels 3–5 mm. long, ascending; sepals oblong, about 4 mm. long, light yellow; petals yellow, 6–7 mm. long, spatulate or oblanceolate, obtuse, gradually narrowed into a more or less distinct claw; pods 3–4 cm. long, about 0.75 mm. in diameter, usually more or less arcuate, beak (*i. e.*, portion above the end of the valves) about 1 mm. long.

This species is closely related to *S. linifolium*, but differs in the more slender and more branched decumbent stem, usually narrower leaves, smaller flowers, and more slender pods, which are more or less arcuate and with a more distinct beak. It grows on dry plains and hills.

MONTANA: Melrose, 1895, *P. A. Rydberg, 2671* (type); Sheridan, 1895, *L. A. Fitch.*

UTAH: Thistle Junction, 1900, *S. G. Stokes.*

COLORADO: Gypsum, 1894, *C. S. Crandall.*

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THE POLYPORACEAE OF NORTH AMERICA—VIII

HAPALOPILUS, PYCNOPORUS AND NEW MONOTYPIC GENERA

By WILLIAM ALPHONSO MURRILL

NEW YORK
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[From the BULLETIN OF THE TORREY BOTANICAL CLUB, **31**: 415-428, August, 1904]

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The Polyporaceae of North America—VIII. Hapalopilus, Pycnoporus, and new monotypic genera

WILLIAM ALPHONSO MURRILL

HAPALOPILUS Karst. Rev. Myc. 3: 18. 1881

This genus was established upon a single species, *H. nidulans* (Fr.), the chief distinguishing characters being an anoderm surface and fleshy-tough context. In his work on Finland basidiomycetes published in 1889 Karsten reduces *Hapalopilus* to a subdivision of the genus *Inonotus*, throwing white-spored and brown-spored forms together. The forms treated under this genus in the present paper are all white-spored, with anoderm, variously marked surface and corky substance. The prevailing color is some shade of brown, the context usually being ferruginous. All the species are dimidiate, sessile and imbricate and grow upon decaying wood. *H. sublilacinus* differs from the other species in growing upon coniferous instead of deciduous wood.

In distribution the species differ widely. *H. rutilans* occurs rather abundantly in the temperate regions of North America and Europe, *H. gilvus* is exceedingly common throughout North America in both temperate and tropical regions and *H. licnoides* is a common tropical American species. The other three are as yet known only from their type localities, which are southern. A very evident line of division exists between *H. rutilans* and the other species, which latter bear distinct evidence of recent common origin. When the great variability of *H. gilvus* is taken into consideration, it appears to be only a question of a comparatively short time before several new species will be evolved.

Synopsis of the North American species

1. Hymenium concolorous, pileus smooth, entirely devoid of zones or furrows, context soft and friable, spores 2.5 × 3.5 μ. 1. *H. rutilans.*
   Hymenium differently colored, pileus rarely smooth, context rigid or corky, not friable. 2.

2. Hymenium lilac-colored, tubes 1 cm. or more in length, pileus concentrically sulcate. 2. *H. sublilacinus.*
   Hymenium dark brown, tubes less than 0.5 cm. in length, pileus smooth or zonate. 3.

3. Context rigid, pileus azonate or with few and indefinite markings. 4.
   Context flexible, pileus plainly and definitely multizonate. 3. *H. licnoides.*

4. Context bright ferruginous, hymenium fulvous to fuliginous, spores elongated, 6 × 2 μ. 4. *H. gilvus.*
   Context pallid, hymenium subfulvous, spores subglobose to ovoid, 3–4 μ in diameter. 5. *H. fulvitinctus.*
   Context brown, hymenium brownish-gray, pileus reddish-brown, finely hispid behind, spores ovoid, 3 × 3.5 μ. 6. *H. hispidulus.*

1. **Hapalopilus rutilans** (Pers.)

Boletus suberosus Bull. Herb. France, **11**: 354. *pl. 482.* 1791.
Not *B. suberosus* L. Sp. Pl. 1176. 1753.
Boletus rutilans Pers. Icon. et Descrip. 18. *pl. f. 4.* 1798–1900.
Polyporus nidulans Fr. Syst. Myc. **1**: 362. 1821.
Polyporus rutilans Fr. Syst. Myc. **1**: 363. 1821.
Hapalopilus nidulans Karst. Rev. Myc. **3**: 18. 1881.
Inonotus nidulans Karst. Finlands Basidsv. 332. 1889.

This species seems to have been described independently under different names by both Bulliard and Persoon, though the name assigned by the former had been previously used by Linnaeus. When Fries studied the plant he gave it the name *P. nidulans*, following it with Persoon's *P. rutilans*, which, he naïvely remarked, was perhaps a variety of *P. nidulans.* The two species were kept distinct by Berkeley, but he had little and poor material and evidently did not know them very intimately.

The plant appears to grow on most deciduous wood, being found on birch, dogwood, hazelnut, hickory, oak and other deciduous trees, with a preference in this country, perhaps, for hickory. Collections are at hand from Paris, *Patouillard;* Connecticut, *Underwood, Earle, White;* Pennsylvania, *Rau, Stevenson;* New York, *Underwood;* Kansas, *Cragin;* Iowa, *Macbride;* Greenland, *Rostrup;* Austria, *Bresadola.*

2. **Hapalopilus sublilacinus** (Ell. & Ev.)

Mucronoporus sublilacinus Ell. & Ev. Bull. Torrey Club, **27**: 50. 1900.

This species was collected by Langlois on pine logs in Louisiana and very doubtfully and provisionally assigned to *H. gilvus.* In some ways it does resemble that species, but it is larger, with concentrically furrowed surface and long, lilac-colored tubes. The spores are hyaline, but very distinct from those of *H. gilvus.*

3. **Hapalopilus licnoides** (Mont.)

Polyporus licnoides Mont. Pl. Cell. Cuba, 401. *pl. 16. f. 2.* 1842.
Polystictus licnoides Fr. Nov. Symb. 92. 1851.
Polystictus subglaber Ell. & Macbr. Iowa Univ. Bull. Nat. Hist. **3**: 193. 1896.

This well-known fungus is exceedingly common in tropical parts of America, occurring on dead wood of various kinds and presenting a variety of forms according to locality and habitat. The best early description of it is that made by Montagne. Fries may have described the species under *P. crocatus*, but this is not yet well determined. According to Romell, *Polyporus xerophyllaceus* Berk. (Hook. Jour. Bot. **8**: 200. 1856), described from Brazilian collections, is a synonym of the present species. Specimens from Guadaloupe in the Paris herbarium are named *Fomes Khortalsii* Lév., which latter is a Sumatran species. Young plants collected in Nicaragua by C. L. Smith have recently received the name *Polystictus subglaber*, said to differ from *P. licnoides* in having smaller pores and no spines. Resupinate forms from the southern states are usually known as *P. crocatus*, possibly because this species was once so identified from South Carolina.

In many ways *H. licnoides* and *H. gilvus* are strikingly alike and approach very near to each other in some varieties, but they are usually readily distinguished by the numerous concentric zones which ornament the surface of the former species. Spores and cystidia correspond closely. *H. gilvus* extends much farther north, however, and is abundantly collected where *H. licnoides* is never found. Among the numerous collections of this species examined are the following: Jamaica, *Underwood, Earle;* Cuba, *Underwood & Earle;* Mexico, *Smith;* Nicaragua, *Smith;* Louisiana, *Langlois;* Florida, *Martin, Calkins, Lloyd.*

4. **Hapalopilus gilvus** (Schw.)

Boletus gilvus Schw. Syn. Fung. Car. 70. 1818.
Polyporus gilvus Fr. Elench. Fung. 104. 1828.
Polyporus calvescens Berk. Ann. Nat. Hist. **3**: 390. 1839,
Polyporus omalopilus Mont. Pl. Cell. Cuba, 423. 1842.
Polyporus carneofulvus Berk. in Fries, Nov. Symb. 68. 1851.
Polystictus purpureofuscus Cooke, Grevillea, **15**: 24. 1886.

Owing to the abundance and wide distribution of this species in America it has figured in many collections and received several different names. This renaming has been due partly to the ignorance of foreign botanists and partly to the importance which varieties assume when studied apart from abundant representative material. The type specimens grew on maple and sweet gum in the Carolinas, where the plant is still found in great abundance. Old specimens from New Orleans were so changed in appearance that Berkeley described them as *P. calvescens.* The thinner tropical form collected in Cuba was called *P. omalopilus* by Montagne, while the stratified form occasionally assumed under tropical conditions is known as *Polyporus carneofulvus* Berk., or *Polyporus holosclerus* Berk. Still another variation, sulcate, thicker and tinged with purple, was collected on hickory in South Carolina (*Ravenel 3034*) and described by Cooke as *P. purpureofuscus.*

In addition to the above specific names, other names with which we have nothing to do have been assigned to our plant, thus increasing the confusion; as, for example, *P. scruposus* Fr., *P. isioides* Berk. and *P. pruinatus* Berk. & Kl., all applied originally to Indian or African species.

The present species is too well known to American mycologists to require further description. It is found on decayed wood of deciduous trees throughout; and except in the Gulf states and south where *H. licnoides* occurs it need not be confused with other species. Collections are at hand from Canada, *Dearness;* Pennsylvania, *Barbour, Sumstine;* Delaware, *Commons;* New York, *Earle, Burnham, George, Underwood, Murrill;* New Jersey, *Ellis, Murrill;* Missouri, *Demetrio;* Ohio, *Selby, Morgan;* Kansas, *Cragin;* Wisconsin, *Baker;* Nebraska, *Clements, Williams;* Virginia, *Murrill;* Georgia, *Harper, Ricker;* Alabama, *Earle, Baker;* Florida, *Calkins;* Louisiana, *Langlois;* Mexico, *Smith;* Cuba, *Earle, Underwood;* Jamaica, *Earle, Underwood;* Porto Rico, *Earle;* Trinidad, *Lloyd.*

5. **Hapalopilus fulvitinctus** (B. & C.)

Polyporus fulvitinctus B. & C. Jour. Linn. Soc. Bot. **10**: 313. 1868.

This species was collected on dead wood in Cuba by Wright. It differs from *H. gilvus* chiefly in having smaller and more rounded spores and paler substance; while in surface characters and consistency the two species are much alike. I know of no collections of the plant except those at Kew, and our knowledge of its habits and distribution is most meagre.

6. **Hapalopilus hispidulus** (B. & C.)

Polyporus hispidulus B. & C. Jour. Linn. Soc. Bot. **10**: 319. 1868.

Collected on decayed wood in Cuba by Wright. Known only from the rather scanty type collections at Kew. Pileus reddish-brown, finely hispid except near the margin, context brown, hymenium brownish-gray, spores ovoid, smooth, hyaline, 3 × 3.5 μ, immature, hyphae very pale ferruginous.

SPECIES INQUIRENDAE

Polyporus crocatus Fr. Epicr. 477. 1836–1838. Described from Leibman's Mexican collections. Transferred to *Polystictus* in Novae Symbolae, 91.1851. Probably a form of *P. licnoides* Mont. I hesitate to reduce *P. licnoides* to synonymy, however, without further investigation.

Polyporus sordidus Berk. in Fries, Nov. Symb. 80. 1851. Name changed to *Polyporus sordidulus* in Cooke's enumeration of polypores owing to the discovery of another species bearing the former name.

Polyporus endozonus Fr. Nov. Symb. 54. 1851. Collected by Oersted on trunks in the Island of San Juan. I have not seen the type of this species. It is said to be very thick and narrow, with smooth, rigid pileus, roughly fibrous context and very small short pores, which become dark umber with age. Fries treats it next to *P. scruposus* and it is certainly not far from *H. gilvus*, but the pileus is too thick and the substance too fibrous for this species.

PYCNOPORUS Karst. Rev. Myc. **3**: 18. 1881

This genus was founded upon a single species, *Pycnoporus cinnabarinus* (Jacq.), and characterized by its author as follows: "Pileus suberosus, intus floccosus. Pori sat firmi." In North America there are two species of the genus, both of them very attractive, abundant and well known. One occurs chiefly in temperate regions and the other is extremely common in the tropics. In the southern United States the two approach quite near each other in some of their forms so that it is not easy to distiuguish them.

Synopsis of the North American species

Pileus thick smooth, opaque; plant abundant in temperate regions.
1. *P. cinnabarinus.*

Pileus thin, often zonate, brilliant red; plant abundant in the tropics.
2. *P. sanguineus.*

1. PYCNOPORUS CINNABARINUS (Jacq.) Karst. Rev. Myc. **3**: 18. 1881

Boletus cinnabarinus Jacq. Fl. Austr. **4**: 2. *pl. 304.* 1776.
Boletus coccineus Bull. Herb. France, 364. *pl. 501. f. 1.* 1791.
Polyporus cinnabarinus Fr. Syst. Myc. **1**: 371. 1821.
Trametes cinnabarina Fr. Nov. Symb. 98. 1851.

This species was known for some time in Europe before receiving the name assigned to it by Jacquin. The type specimens were sent from Carinthia by Wulfen, and Jacquin states that it is parasitic on trees in subalpine districts of Austria. It is now known to occur on various deciduous trees in Europe, Asia and North America. Bulliard's fine figures were made from plants growing on cultivated cherry. Fries assigned it to his new genus *Trametes* in 1851 and Saccardo has listed it under two genera in his Sylloge. Its nearest ally is *P. sanguineus*, a tropical species, from which it differs in being thicker, more opaque in color, anoderm, and in having larger tubes with thicker dissepiments. There is also no zonate form of *P. cinnabarinus.*

The sporophores appear in this latitude in the latter part of June and mature quickly. In the earlier stages they are very soft, spongy and elastic, light orange in color and clothed with numerous slender delicate hairs which give them a pruinose appearance. Later the hairs disappear, the color becomes darker and the margin thicker. Not infrequently the old sporophores revive and take on an additional stratum of tubes, the new growth extending outward and upward over the former margin so as to entirely conceal it from view.

Exsiccatae: Finland, *Karsten;* New York, *Clinton, Blake, Murrill;* New Jersey, *Anderson;* Pennsylvania, *Barbour, Sumstine, Stevenson;* South Carolina, *Ravenel;* West Virginia, *Nuttall;* Virginia, *Murrill.*

2. **Pycnoporus sanguineus** (L.)

Boletus sanguineus L. Sp. Pl. ed. 2. 2: 1646. 1762.
Xylometron sanguineum Paul. Icon. Champ. *pl. f. 3, 4.* 1793.
Polyporus sanguineus Mey. Fl. Esseq. 304. 1818.
Polystictus sanguineus Fr. Nov. Symb. 75. 1851.

This highly attractive fungus has been known from ancient times on account of its great abundance and brilliant coloring. The type locality is given by Linnaeus as Surinam, South America, but herbaria are abundantly supplied with it from most tropical regions the world over. Paulet's figure is cited only because of his generic name; no drawing could be poorer than this one, which seems to be only a mechanical design for the corner of his plate, resembling the plant in color but in no other way.

As to habitat and host, this species exhibits little choice, occurring on standing or fallen dead trunks and structural timbers of almost any kind of deciduous or evergreen tree. According to Swartz, it was formerly eaten by the negroes in its young stages; but it is certainly too tough for any ordinary use in this way.

Of the large number of exsiccati examined, I need mention only a few: North Carolina, *Raasloff;* South Carolina, *Ravenel, Du Bois;* Georgia, *Frank, Harper;* Florida, *Lloyd, Small & Carter;* Cuba, *Underwood & Earle, Britton, Shafer;* Jamaica, *Earle;* Porto Rico, *Howe;* Hayti, *Nash;* San Domingo, *Wright;* Bahamas, *Minns;* Trinidad, *Lloyd;* Mexico, *Smith;* Nicaragua, *Smith;* Honduras, *Wilson;* Columbia, *Baker;* Uruguay, *Lorentz;* Paraguay, *Balansa;* Bolivia, *Rusby;* Peru, *Pearce;* Bonin Islands, *Wright.*

Abortiporus gen. nov.

Hymenophore annual, tough, humus-loving; stipe normally central, often obsolete; context yellowish-white, duplex, spongy above, woody below, tubes thin-walled, mouths polygonal; spores subglobose, smooth, hyaline.

The type of this genus is *Boletus distortus* Schw. (Syn. Fung. Car. 71. 1818), a very variable species found about old stumps in various localities in the Eastern United States. The name assigned to the genus refers to the usual aborted form of the fruit body, in which the tubes with their abundant contents appear prematurely before the development of the pileus is complete.

Abortiporus distortus (Schw.).

Boletus distortus Schw. Syn. Fung. Car. 71. 1818.
Polyporus abortivus Peck, Bot. Gaz. 6: 274. 1881.

The ordinary form of the fruiting body of this species has the appearance of being badly aborted in its development, only a few of the pilei reaching their full size. In its arrested form the pileus is a mass of pores filled with spores. The species has been badly confused with *P. rufescens* of Europe, but a study of that species in the field easily shows a very marked difference. A small specimen of our plant is to be found in the Paris herbarium under the name of *Polyporus pulvillus* Mont., but this name was never published for it so far as I know. The specimen is from South Carolina.

This species occurs about stumps, roots and other dead wood of deciduous trees, such as the oak, maple, *Ailanthus*, etc. Its distribution is quite general throughout the eastern part of North America and it has been found as far west as Wisconsin and Texas.

Exsiccatae: Canada, *Dearness;* Connecticut, *Earle;* Delaware, *Commons;* New Jersey, *Ellis;* Pennsylvania, *Rau, Gentry, Herbst;* Ohio, *Lloyd, Morgan, Dawson;* Missouri, *Demetrio;* Wisconsin, *Miss Patterson;* Alabama, *Earle & Baker;* Louisiana, *Langlois;* Texas, *Gentry.*

Cyclomycetella gen. nov.

Hymenophore annual, tough, epixylous, sessile, anoderm, zonate; context thin, fibrous, brown, tubes short, thin-walled, mouths polygonal, becoming concentrically elongated in some species by the splitting of the radial walls; spores ellipsoidal, smooth, ferruginous.

This genus is based upon *Boletus pavonius* Hook. (Kunth, Syn. Pl. **1**: 10. 1822), described from Colombia. Its nearest ally is the old-world genus *Cyclomyces*, erected by Fries in 1830 upon *Cyclomyces fuscus.* In this latter genus the tubes are continuous concentric furrows, while in the species of *Cyclomycetella* which come nearest to *Cyclomyces* the concentric appearance of the hymenium is caused by the partial splitting of the radial walls in age; and the formation of furrows is by no means constant.

Cyclomycetella pavonia (Hook.).

Boletus pavonius Hook. in Kunth, Syn. Pl. **1**: 10. 1822.
Polyporus pavonius Fr. Epicr. 477. 1836–1838.
Polyporus iodinus Mont. Ann. Sci. Nat. II. Bot. **16**: 108. 1841.

The type plants of Hooker's species were collected by Humboldt in Colombia, or New Granada as it was then called, and named for *Ulva pavonia* because of the concentric lines of the pileus. Montagne's types were from Guiana, collected by Leprieur. He first thought that these plants were *P. striatus* (Hook.), but later placed them midway between this species and *P. tabacinus* Mont., making no mention of Hooker's other species, *P. pavonius*, described just before.

Other closely related species are found in South America. *B. striatus* Hook. (Kunth, Syn. Pl. **1**: II. 1822), was described from plants collected by Humboldt in Peru, and has since been found in Venezuela. *P. vespilloneus* Berk. (Hook. Jour. 8: 1856) was described from Juan Fernandez Island and later reported by Montagne from Chile. All these species show very recent common origin. *P. Hasskarlii*, a Ceylon species, has several times been erroneously reported from Cuba.

Cycloporus gen. nov.

Hymenophore annual, tough, anoderm, terrestrial, orbicular, centrally stipitate; context soft, spongy, ferruginous; pores at first polygonal, soon becoming continuous concentric furrows, dissepiments thin, lamelloid; spores ovoid, smooth, ferruginous.

The type of this genus is *Cyclomyces Greenei* Berk. (Lond. Journ. Bot. 4: 306. *pl. 11.* 1845), a very rare plant found in temperate regions of North America. The genus *Cycloporus* differs widely from *Cyclomyces* in being terrestrial and stipitate instead of epixylous and sessile.

Cycloporus Greenei (Berk.)

Cyclomyces Greenei Berk. Lond. Jour. Bot. **4**: *pl. 11.* 1845.

This remarkable plant has been eagerly sought for by collectors since its discovery in New England by Greene and still the number of specimens found is hardly a dozen. It may at once be distinguished from all other pore-fungi by its concentric, gill-like tubes and central stem. It grows on the ground in woods. Specimens have been examined from Massachusetts, *Greene*, *Sprague;* New York, *Peck;* Connecticut, *Earle;* New Jersey, *Gentry;* Iowa, *McBride;* West Virginia, *Nuttall;* Vermont, *Farlow.* Five of these collections are in the herbarium of the New York Botanical Garden.

Globifomes gen. nov.

Hymenophore large, woody, encrusted, perennial, epixylous, compound; context ferruginous, punky, tubes cylindrical, thick-walled, stratose: spores ovoid, smooth, ferruginous.

The type of this genus is *Boletus graveolens* Schw. (Syn. Fung. Car. 71. 1818), a rather rare plant first found in Georgia and the Carolinas, but later discovered as far west as Iowa. The genus is readily distinguished among its allies by its compound pileus, which consists of numerous small, closely imbricated pileoli united into a compact rounded mass.

The genus *Xylopilus* of Karsten (Hattsv. **2**: 69. 1882), is also described as having a compound pileus, but *Xylopilus crassus* (Fr.) Karst., its type species, is very probably only an abnormal form of a European species of *Elfvingia;* and even if this type plant were found to be normal the genus *Globifomes* would remain sufficiently distinct.

Globifomes graveolens (Schw.)

Boletus graveolens Schw. Syn. Fung. Car. 71. 1818.
Polyporus conglobatus Berk. Lond. Journ. Bot. **4**: 303. 1845.
Fomes graveolens Cooke, Grevillea, **13**: 118. 1884.

This species was first sent to Schweinitz from Georgia, but was later found in North Carolina. Plants sent from Ohio to Berkeley were thought to differ sufficiently from those growing on oak to justify a new name. The heavy odor of the fruiting plant is thought to be responsible for the common name of "Sweet Knot," by which it is known in some sections.

The most common host of this species is the oak, especially *Quercus nigra*; but it also occurs on beech. The fruit bodies are found on old dead trunks.

Exsiccatae: Rav. Fung. Car. **3**: 8; Ell. N. A. Fung. 603; Ohio, *James*, *Cheney*; Iowa, *Macbride*; Pennsylvania, *Sumstine*.

Nigrofomes gen. nov.

Hymenophore large, perennial, epixylous, sessile; context woody, purple, tubes cylindrical, stratose, thick-walled, black; spores ovoid, smooth, hyaline.

The type of this genus is *Polyporus melanoporus* Mont. (Pl. Cell. Cuba, 422. 1842), found on trunks of trees in tropical America. The genus is readily distinguished from its near allies by its purple context and black tubes.

Nigrofomes melanoporus (Mont.)

Polyporus melanoporus Mont. Pl. Cell. Cuba, 422. 1842.

This species is the darkest-colored of the perennial polypores. It was first described from collections made in Cuba by Ramon de la Sagra. Underwood has also collected it several times in Jamaica and Florida and Smith has found it in Nicaragua. It is probably more or less common throughout tropical America on decaying trunks of various broad-leaved trees.

Poronidulus gen. nov.

Hymenophore annual, tough, sessile, epixylous, at first sterile and cup-like, the fertile portion developing from the sterile; context white, fibrous, tubes short, thin-walled, mouths polygonal; spores ellipsoidal, smooth, hyaline.

The type of this genus is *Boletus conchifer* Schw. (Syn. Fung. Car. 72. 1818), a very common and abundant species on dead elm branches. The development of the fruit-body is peculiar, being in two stages, the first ending with the formation of a cup-shaped sterile body, from which the fruit-body proper later develops. This preliminary pileus begins as a knot of whitish mycelium, which soon ceases to grow at the center, while the hyaline borders continue to grow upward and form a cup resembling species of *Nidularia*. The margin of the cup is thin and entire or undulate and becomes darker like the center when the limit of growth is reached, while the concentric zones within very plainly show the progress of the development. The cup varies from deeply infundibuliform to shallow or even flat at times and the central portion which has ceased to grow is much cracked radially to accommodate itself to the growing exterior.

The pileus proper usually arises from one side of the cup near its base and expands laterally into a reniform, zonate hymenophore considerably larger than the sterile portion. At times the pileus does not develop beyond the surface of the cup and at other times a developed pileus becomes proliferous at several points and give rise to new sterile and fertile portions. Since the formation of the cups continues throughout the growing season, many are overtaken by winter and are found among the new ones the following spring. The old pilei rarely remain over winter, being fragile and readily devoured by insect larvae.

Poronidulus conchifer (Schw.)

Boletus conchifer Schw. Syn. Fung. Car. 72. 1818.
Boletus virgineus Schw. Syn. Fung. Car. 72. 1818.

This species was first described from North Carolina, but it is known to be common in many parts of North America on fallen branches and dead limbs of the elm, its only host. Under the first name Schweinitz described forms that showed the cups attached to the developing pilei; under the second he placed fully developed fruit bodies showing little trace of the sterile part from which they sprang. The plant is confined to North America. Among collections examined are the following: Massachusetts, *King;* Connecticut, *White;* New Hampshire, *Minns;* New York, *Earle*, *Murrill;* New Jersey, *Earle*, *Murrill;* Ohio, *Lloyd;* Virginia, *Murrill;* Alabama, *Earle;* Kansas, *Bartholomew*.

A brief synopsis of the genera treated in articles I-VIII of this series

- Surface of hymenophore covered with reddish-brown varnish, context corky. *Ganoderma.*
- Surface of hymenophore not as above, or, if so, context woody.
  - Hymenophore annual.
    - Tubes hexagonal and radially elongated. *Hexagona.*
    - Tubes not as above.
      - Hymenophore stipitate.
        - Stipe compound. *Grifola.*
        - Stipe simple.
          - Context white.
            - Plants fleshy, terrestrial. *Scutiger.*
            - Plants tough, epixylous.
              - Pileus inverted, erumpent from lenticels. *Porodiscus.*
              - Pileus erect, not erumpent.
                - Context homogeneous, firm. *Polyporus*
                - Context duplex, spongy above, woody below. *Abortiporus.*
          - Context brown.
            - Hymenium concentrically lamelloid. *Cycloporus.*
            - Hymenium poroid.
              - Spores white. *Romellia.*
              - Spores brown.
                - Pileus erect, stipe central. *Coltricia.*
                - Pileus inverted, pendent. *Coltriciella.*
      - Hymenophore sessile.
        - Context white.
          - Tubes at length separating from the context, surface smooth. *Piptoporus.*
          - Tubes not separating from the context, surface zonate. *Poronidulus.*
        - Context red. *Pycnoporus.*
        - Context brown.
          - Spores white. *Hapalopilus.*
          - Spores brown. *Cyclomycetella.*
  - Hymenophore perennial.
    - Context and tubes white or pallid.
      - Hymenium at first concealed by a volva. *Cryptoporus.*
      - Hymenium free from the first. *Fomes.*
    - Context and tubes brown or dark red.
      - Hymenophore subsessile, caespitose, the numerous pileoli arising from a common trunk or tubercle. *Globifomes.*
      - Hymenophore truly sessile, either simple or imbricate.
        - Pileus covered with a horny crust, context punky. *Elfvingia.*
        - Pileus not covered with a horny crust or, if encrusted, context hard and woody. *Pyropolyporus.*
    - Context and tubes dark purple or black. *Nigrofomes.*

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Pyropolyporus	30 : 109.	1903
Romellia	31 : 338.	1904
Scutiger	30 : 425.	1903

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CONTRIBUTIONS FROM THE NEW YORK BOTANICAL
GARDEN—No. 57

STUDIES IN THE ASCLEPIADACEAE—VIII

A NEW SPECIES OF ASCLEPIAS FROM KANSAS AND TWO POSSIBLE HYBRIDS FROM NEW YORK

By ANNA MURRAY VAIL

NEW YORK

1904

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, **31**: 457-460, *pl. 16-19.* Sept., 1904]

[From the Bulletin of the Torrey Botanical Club, 31 : 457-460, *pl. 16-19* September, 1904.]

Studies in the Asclepiadaceae — VIII

A NEW SPECIES OF ASCLEPIAS FROM KANSAS AND TWO POSSIBLE HYBRIDS FROM NEW YORK

Anna Murray Vail

(With plates 16–19)

Asclepias kansana sp. nov.

Stems erect, very stout, canescently tomentose throughout, 2 dm. (or more?) high: leaves approximately opposite, short-petioled; basal blades broadly oblong-ovate, truncate and rounded at the base, obtuse and mucronulate or emarginate at the apex, the upper ones elliptical-oblong, also mucronulate or more often emarginate, the lower ones 13–16 cm. or more long, 9–11 cm. wide, the upper ones 9–14 cm. long and 4.5–9 cm. wide, minutely tomentose or becoming glabrate above, densely canescently tomentose beneath, becoming less so with age, the midvein very broad and conspicuous, the primary veins wide-spreading; petioles stout, 1–1.5 cm. long: umbels several, axillary on the upper part of the stem, peduncled, many-flowered; peduncle 3–7 cm. long; pedicels 2–3 cm. long, tomentose: calyx-segments oblong-lanceolate: corolla-segments (pink-purple?), oblong, 7–8 mm. long, tomentose on the outside; hoods oblong, about 4 mm. long, erect but diverging at the obtuse apex (pinkish?), the lateral margins infolded with a broad obtuse tooth on each side at about the middle, the tips of which meet under the exserted incurving horn; horn falcate, affixed near the base of the hood, and incurving over the edge of the anthers: follicles erect, on recurved pedicles, 8–10 cm. long, 3–3.5 cm. wide, obtuse at the curved apex, densely white-tomentose, echinate with numerous soft spinose processes that vary in length from 3–10 mm.; seeds 8 mm. long. (Plate 16, figure 4; Plate 18.)

Kansas: Fort Riley, *E. E. Gayle 514*, June 24, 1892; Manhattan, Riley County, *W. A. Kellerman*, 1890; Riley County, *J. B. Norton 762*, 1896 (type, in the Herbarium of the New York Botanical Garden.)

A specimen labelled *A. syriaca* L. from Independence, Mo., *B. F. Bush 355*, June, 1895, might be referred here, the leaf-characters being clearly those of *A. kansana*, but the flowers are in too poor condition to study. A specimen from Osborne County, Kansas, *C. L. Shear 130*, June 22, 1894, also labelled *A. syriaca* L., without flowers, appears to belong here.

Differing from *Asclepias syriaca* L. in its broader oblong-ovate and oblong-elliptical leaves, in the erect-spreading hoods that are narrower at the apex, and in the character and greater number of the processes of the densely tomentose follicles.

Asclepias syriaca L. from the Eastern States has longer, narrower, more acute leaves, shorter, more rounded and erect corolla-hoods and follicles that are much less tomentose and have fewer and much shorter processes. (PLATE 16, FIGURES 1*a* and 1*b*; PLATE 17, FIGURE 1, *a–f*.)

Asclepias Bicknellii sp. nov.

Stems erect, glabrous or strigilose in lines above, glaucous, 3 dm. or more high: leaves opposite, short-petioled; blades oblong or the upper ones elliptical-oblong, 11–16 cm. long, 3.5–8 cm. wide, acute at the apex, truncate or rounded or sometimes subcordate at the base, glabrous or nearly so above, paler, glaucous and sparingly strigilose beneath, undulate on the margins; petioles 2–5 mm. long: umbels terminal and axillary; peduncles 6–9 cm. long, strigilose; pedicels slender, 2–2.5 cm. long, strigose: calyx-segments ovate-lanceolate, acute, glabrate; corolla-segments oblong, 7 mm. long, pale greenish, tinged with purple, glabrous; hoods erect, 4 mm. high, rounded and somewhat pendulous at the saccate base, pale pink, crenately notched or undulate at the apex; horn falcate, flat, arising from the base of the hood, long-exserted over the anthers: follicles not known. (PLATE 19.)

Van Cortlandt Park, New York City, collected by E. P. Bicknell, June 25, 1895. Type in the Herbarium of Columbia University (N. Y. Botanical Garden).

A possible hybrid appearing to be intermediate between *A. syriaca* L. and *A. amplexicaulis* Smith or *A. exaltata* (L.) Muhl. Named in honor of Mr. E. P. Bicknell.

A single plant found growing on a railroad embankment with *A. syriaca* L., "and *A. purpurascens* L. a not distant neighbor" (Bicknell in litt.). Its leaves resemble closely those of *A. purpurascens* L., but with the undulate marginal characters of *A. amplexicaulis* Smith; but the flower and hood characters are nearer those of *A. exaltata* (L.) Muhl. than of any of the other related Northeast American species. The leaves of *A. exaltata* are very thin and acute at each end, those of *A. Bicknellii* being more nearly of the texture of those of *A. syriaca,* but without the canescent pubescence of the latter species. *A. exaltata* was not known to grow in the vicinity.

Asclepias intermedia sp. nov.

Stems erect, glabrous, purplish, not glaucous, 3 dm. or more high: leaves opposite, on very short but distinct petioles, or possibly the lowest sessile; blades oblong-elliptical, thinnish, yellow-green and glabrous above, paler and minutely pubescent beneath, the midvein reddish above, the primary veins wide-spreading, also tinged with red, 8–14 cm. long, 3–7 cm. wide, obtuse or the upper ones subcordate at the base, obtuse and apiculate at the apex, most of the margins undulate; petioles 1–3 mm. long: umbels terminal, 2 or more, short-peduncled, or subtended by an upper leaf, 16–24-flowered; peduncles minutely and sparingly pubescent, 2–8 cm. long; pedicels 2.5–3 cm. long, slender, minutely pubescent: calyx-segments ovate, acute, pubescent, especially toward the apex; corolla green-purple, its segments oblong-lanceolate, 6–8 mm. long; hoods erect, ovate-lanceolate, obtuse, 5–6 mm. long, pinkish purple with a darker red or purplish stripe down the back, the lateral margins incurved, each with an erect tooth somewhat above the middle; horn slender, arising from about the middle of the hood, the tips incurved and meeting over the anthers; follicles not known. (Plate 16, figure 2; plate 17, figure 2, *a–f.*)

Lawrence, Long Island, collected by E. P. Bicknell, July 17, 1904. Type in the Herbarium of the New York Botanical Garden.

A possible hybrid. It appears to be intermediate between *Asclepias syriaca* L. (Plate 16, figure 1 *a*, 1 *b*; Plate 17, figure 1, *a–f*) and *A. amplexicaulis* Smith (Plate 16, figure 3; Plate 17, figure 3, *a–f*). It differs from the latter in its narrower, brighter green leaves that are distinctly petioled and pubescent beneath, and also somewhat less undulate on the margins. The umbels resemble those of *A. syriaca* in contrast to the long-peduncled terminal umbels of *A. amplexicaulis.* The flowers are intermediate between the two species, with the characteristic distinct stripe down the back of the hood that appears in fresh specimens of *A. amplexicaulis.* The hoods of *A. amplexicaulis* vary very greatly in size, and in the undulations of their apical margins.

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Explanation of plates 16-19

PLATE 16

1*a. Asclepias syriaca* L., follicle. 1*b. Asclepias syriaca* L., leaf. 2. *Asclepias intermedia* Vail, leaf. 3. *Asclepias amplexicaulis* Smith, leaf. 4. *Asclepias kansana* Vail, follicle.

Figures 1*a*, 1*b* and 3 were drawn from fresh material; 2, from the fresh type specimen; 4, from specimen collected by W. A. Kellerman, 1890. All figures ⅔ nat. size.

PLATE 17

1. *Asclepias syriaca* L. 2. *Asclepias intermedia* Vail. 3. *Asclepias amplexicaulis* Smith.

Figures 1 and 3 were drawn from fresh material; 2, from type specimen.

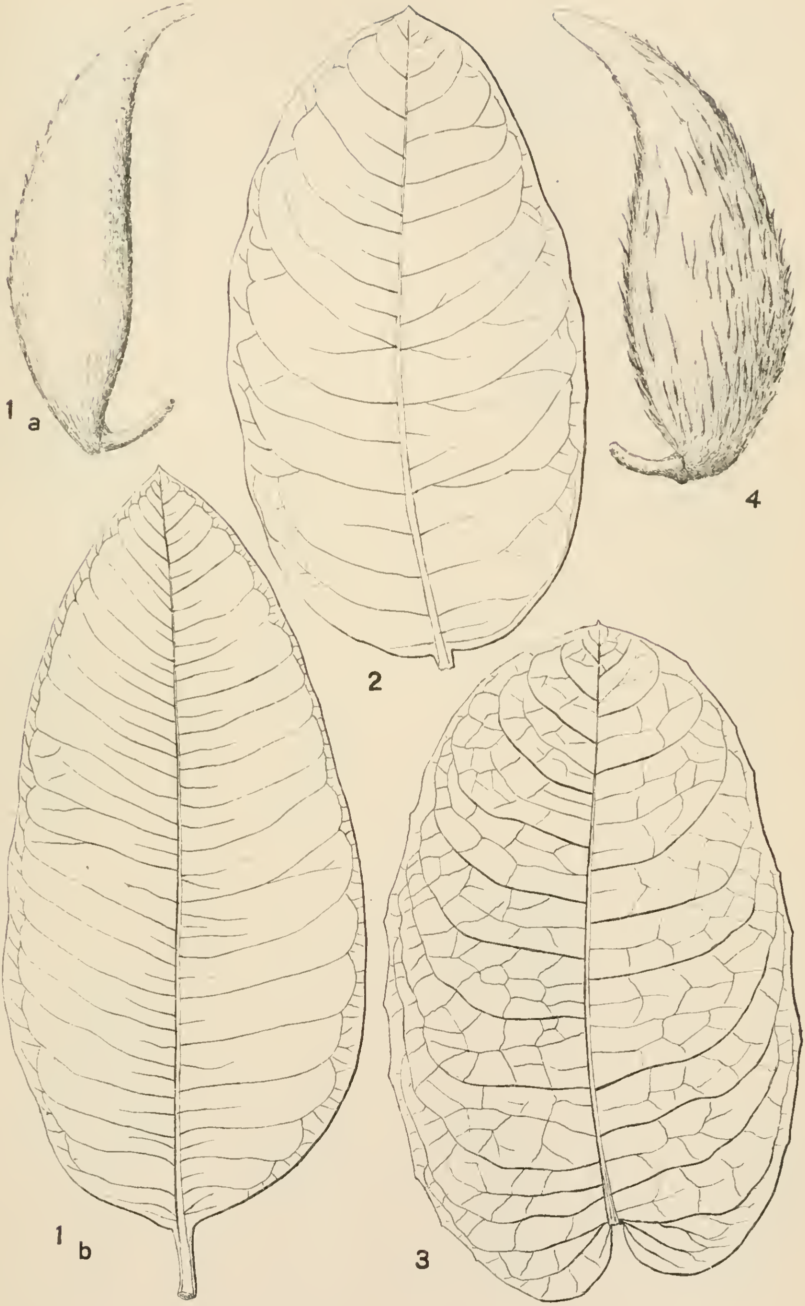
In each case *a*, flower, × 2. *b*, calyx-segments, × about 6. *c*, hood, front view, × about 6. *d*, hood, side view, × about 6. *e*, gynostegium, × about 6. *f*, pollinia, × 14.

PLATE 18

Asclepias kansana Vail. *a*, flower. *b*, calyx-segments. *c*, hood, front view. *d*, hood, side view. *e*, gynostegium. *f*, pollinia. *g*, basal leaf. *h*, upper stem leaf. The figures were all drawn from *no. 762*, collected by J. B. Norton, 1896.

PLATE 19

Asclepias Bicknellii Vail. *a*, flower. *b*, calyx-segments. *c*, hood, front view. *d*, hood, side view. *e*, gynostegium. *f*, pollinia. *g*, basal leaf. *h*, stem leaf. The figures were all drawn from the type specimen, when fresh.



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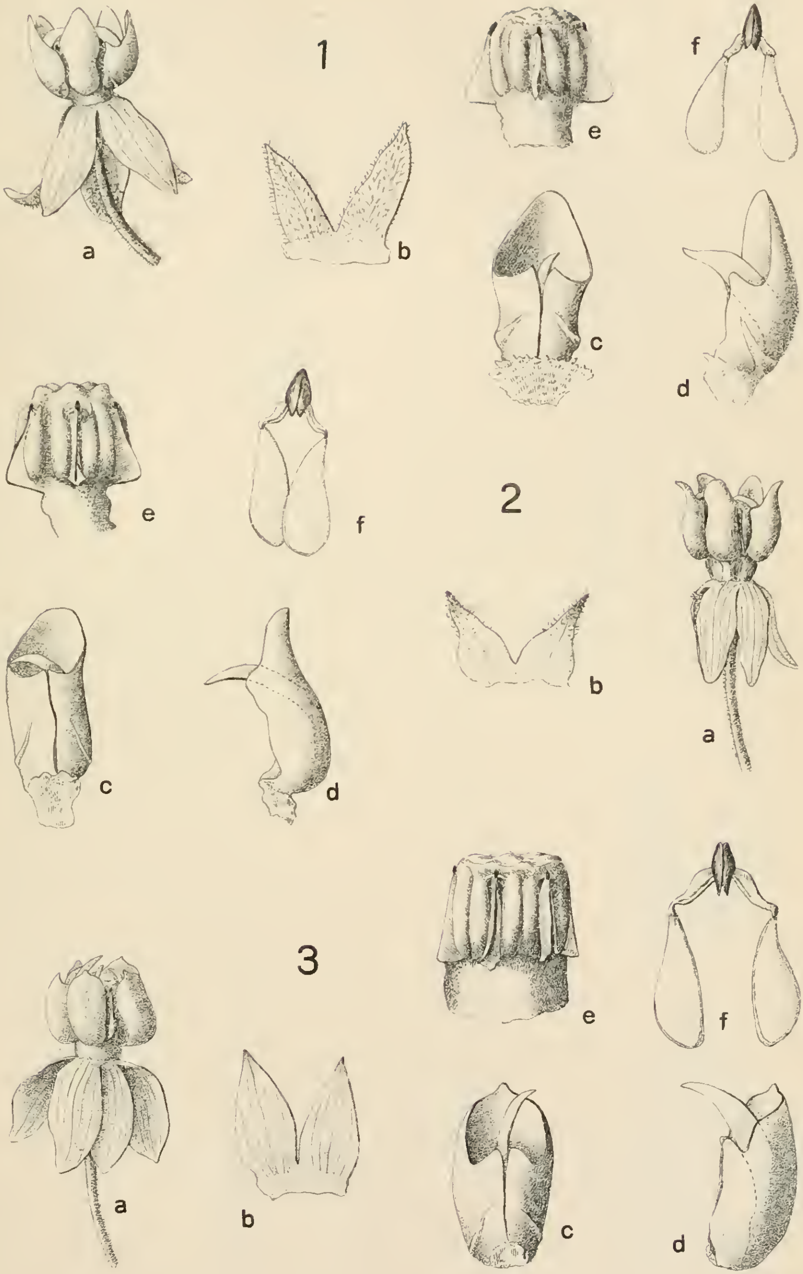
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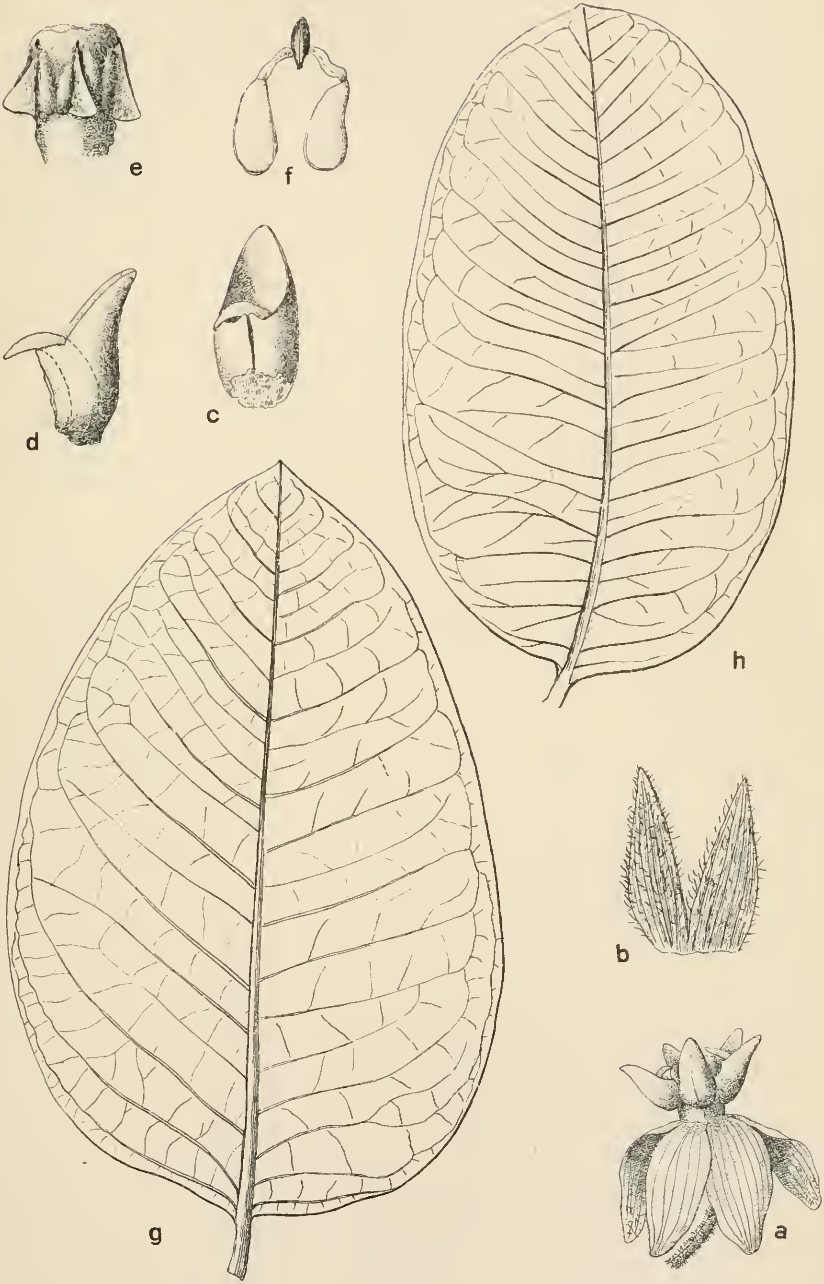
1. ASCLEPIAS SYRIACA L.
2. ASCLEPIAS INTERMEDIA Vail.
3. ASCLEPIAS AMPLEXICAULIS Smith.



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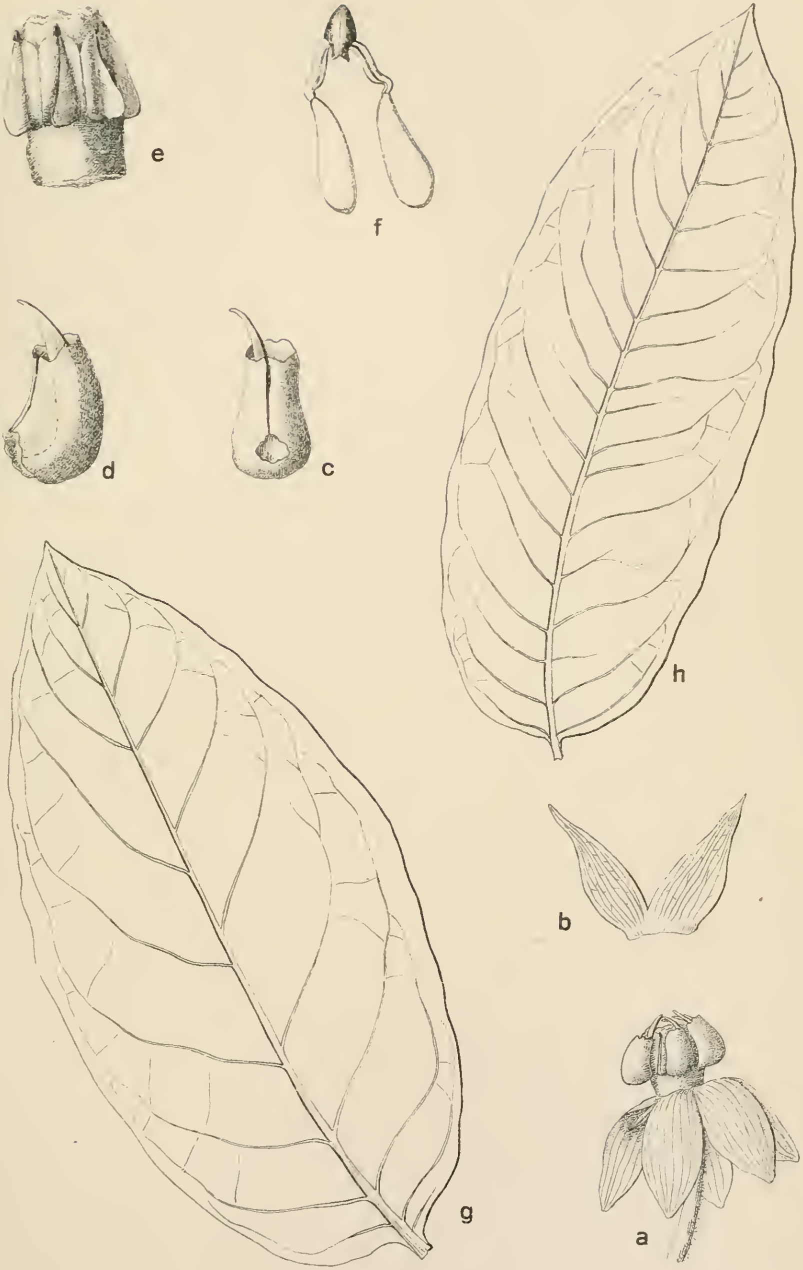

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RELATIONSHIP OF MACROPHOMA AND DIPLODIA

By JULIA T. EMERSON

NEW YORK
1904

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, **31**: 551-554. *pl. 25.* October, 1904]

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, 31: 551-554, *pl. 25*. October, 1904.]

Relationship of Macrophoma and Diplodia

JULIA T. EMERSON

(WITH PLATE 25)

In December, 1902, Mr. Earle brought back to the New York Botanical Garden from Jamaica, West Indies, various collections of cocoanut affected with diseases. One set was handed over to the writer to see how it would develop when grown in cultures. It was *no. 510*, collected at Bowden, Jamaica, November 18, 1902, on flower-bud spathes of *Cocos nucifera*, labelled "dying of wasting disease." The spathes were covered with black spots just visible to the unaided eye, which proved to be pycnidia of *Macrophoma* and *Diplodia*, so closely associated that from one point both the hyaline unicellular *Macrophoma* spores and the brown two-celled *Diplodia* spores could be secured.

In March, 1903, cultures were started from the spathes by scraping off some of the black pycnidia where *Macrophoma* spores had previously been found, examining with a microscope and transferring a few spores to ordinary neutral agar. In the same manner cultures were taken from spathes where *Diplodia* spores had been seen. In this way two sets of cultures from each kind of spore were obtained, with reasonable assurances that they started one from pure *Macrophoma* spores and the other from pure *Diplodia*.

At first only agar and potato were used as media, then bread and milk, bread and water and pith and blade of cocoanut leaf were added. All the cultures were kept in a dark room where the temperature was uniformly at about 24°C. In five days or less after sowing spores or mycelium on agar, vigorous, spreading colonies of silky hyphae were evident. When they were still young, however, it was found best to transfer them to one of the other media; for this fungus will not develop well on agar alone, active growth ceasing in a week or ten days and a few dark chlamydospores being the only result; whereas on potato and the other materials the growth is vigorous and rapid from the beginning. In spite of such good growth pycnidia develop slowly and sparingly on potato but very freely on cocoanut pith. It was not possible to obtain young healthy cocoanut plants which could be inoculated with pure *Macrophoma* in order to prove whether it was parasitic or simply saprophytic. When fresh leaves from a greenhouse were used for inoculation, moulds and other fungi which were already established quite prevented the *Macrophoma* from growing at all.

In the development of the fungus, first a white film of mycelium spreads quickly over most of the medium; in about a week parts become dark green and gradually black, and in ten days to two weeks from the sowing the pycnidia are formed. On cocoanut pith, bread or potato cultures these were often quite above the substratum, even as early as eight or nine days from the sowing, when they looked like tiny green bubbles covered with hyphae. Even in this immature condition the *Macrophoma* spores were abundant; being pale green, granular and often containing what appeared to be oil-drops, and seeming to have more abundant contents than those from maturer pycnidia. In a damp atmosphere the *Macrophoma* spores are apt to come out of the mouth of the pycnidia and form a white mass. No spores which resembled conidiospores were noticed, but there were several other forms which seemed to be sclerotial or resting in their function. Soon after the green color came in a culture, on examining the mycelium it would be seen that a few cells or as many as eight in a hypha had become round or oblong, thick-walled, brown, sometimes quite rough, $25–29 \mu \times 8–18 \mu$. They germinate very readily, putting out several tubes from one spore (FIGURE 4). Sometimes two of these will cling together and the two might easily be mistaken for a *Diplodia* spore. Around the outside of the pycnidium there is apt to be a mass of empty two-celled bodies, one cell being slightly smaller than the other, as in a *Puccinia* teleutospore. Possibly they are merely short, swollen hyphae similar to the cells which make the outside wall of the pycnidium.

From the time the cultures were first obtained pure it was evident that the growths of *Macrophoma* and *Diplodia* were very much alike, as had been suspected from their close association and the similarity of their pycnidia. So it was with no little pleasure that pycnidia were noticed on two seperate cultures, one pure *Macrophoma* and the other pure *Diplodia.* Cultures on cocoanut pith started January 11th showed on January 23d pycnidia with an abundance of *Macrophoma* spores in each of the cultures, and on February 12th there was obtained from the same pycnidium both unicellular hyaline *Macrophoma* spores and bicellular brown *Diplodia* spores. This is the average time that it takes a pure culture on the most favorable medium to develop, namely 10–12 days for pycnidia with *Macrophoma* spores and 12–18 days more before *Diplodia* spores are also abundant. There may be a slightly earlier development of the two-celled spores in the pycnidia of cultures from *Diplodia* spores than those from *Macrophoma*, but in general there is no difference in appearance of mycelium, size, or shape of spores or pycnidia. There certainly seems to be no doubt that the unicellular white *Macrophoma* spores in the pycnidia are simply the immature forerunners of the mature *Diplodia* spores.

In microtome sections of the leaf with the fungus growing on it from a culture five weeks old, the cells near the pycnidium seem much disorganized by the intercellular hyphal threads, being contracted into irregular darkly-stained masses and the cell-walls being difficult to trace. This affected area extends along the lower part of the leaf to some distance on either side of the pycnidium, but does not go through to the upper side.

Material for microtome sections was put into weak Flemming's solution to kill and fix. It was then washed in water, dehydrated, and imbedded in paraffin. Some sections were mounted in Canada balsam without any staining, but the *Macrophoma* spores proved to be almost invisible and some of the *Diplodia* spores too dark. As the pycnidia are very black an attempt was made to decolorize the sections by putting them into hydrogen peroxide and alcohol for about five hours. After washing they were stained in saffranin, gentian violet and orange gentian and mounted in balsam. This combination stains the *Macrophoma* spores orange and the rest of the pycnidium brown, but care must be taken not to overstain. The most satisfactory staining method was saffranin ten minutes, Delafield's hematoxylin five minutes, washing out excess of stain with acidified alcohol, and mounting in balsam. In this way the *Macrophoma* spores are stained light purple and the rest of the fungus brown, while the leaf-tissues become brown or red.

The *Macrophoma* form of this species was described originally by Cooke in Grevillea (**5**: 101), under the name *Sphaeropsis palmarum*, as follows:

"Erumpens. Peritheciis subglobosis, applanatis, demum superne detectis, atris; sporis ellipticis, hyalinis, intus granulosis. On petioles and midribs of *Cocos nucifera*. Demerara. Spores .02 × .012 mm. Perithecia rather large, splitting the cuticle."

On the next page of the same paper Cooke thus describes the *Diplodia* form under the name *Diplodia epicocos*:

"Sparsa vel subgregaria. Peritheciis demum superficialibus vel semi-immersis, globosis, atris; sporis ellipticis, uniseptatis, constrictis, brunneis. On dead young leaves of *Cocos nucifera*. Spores .022 × .01–.012 mm. Externally resembling a small *Sphaeria* of the section *Denudatae*."

In the following description I have included both stages:

Pycnidia buried to erumpent, sometimes becoming superficial, black, carbonaceous, opaque, cells indistinct, 150–250 μ in diameter, subgregarious, globose or conical at the mouth; *Macrophoma* spores elliptical or ovoid, obtuse, hyaline, granular, 20–25 × 10 μ. *Diplodia* spores elliptical, one septate, brown, obtuse, sometimes slightly constricted, 20–25 × 10 μ; spores borne on simple hyaline sporophores 12–15 by 2–3 μ, hyaline and brown spores in the same way, without any order; mycelium of contorted, irregular, septate threads, brown near the pycnidia and when old.

Explanation of plate 25

Fig. 1. Three pycnidia breaking through the epidermis of cocoanut spathe. Seen from above. × 44.

Fig. 2. The single pycnidium from Fig. 1. × 44.

Fig. 3. *Macrophoma* and *Diplodia* spores. × 280.

Fig. 4. Chlamydospores sprouting. × 192.

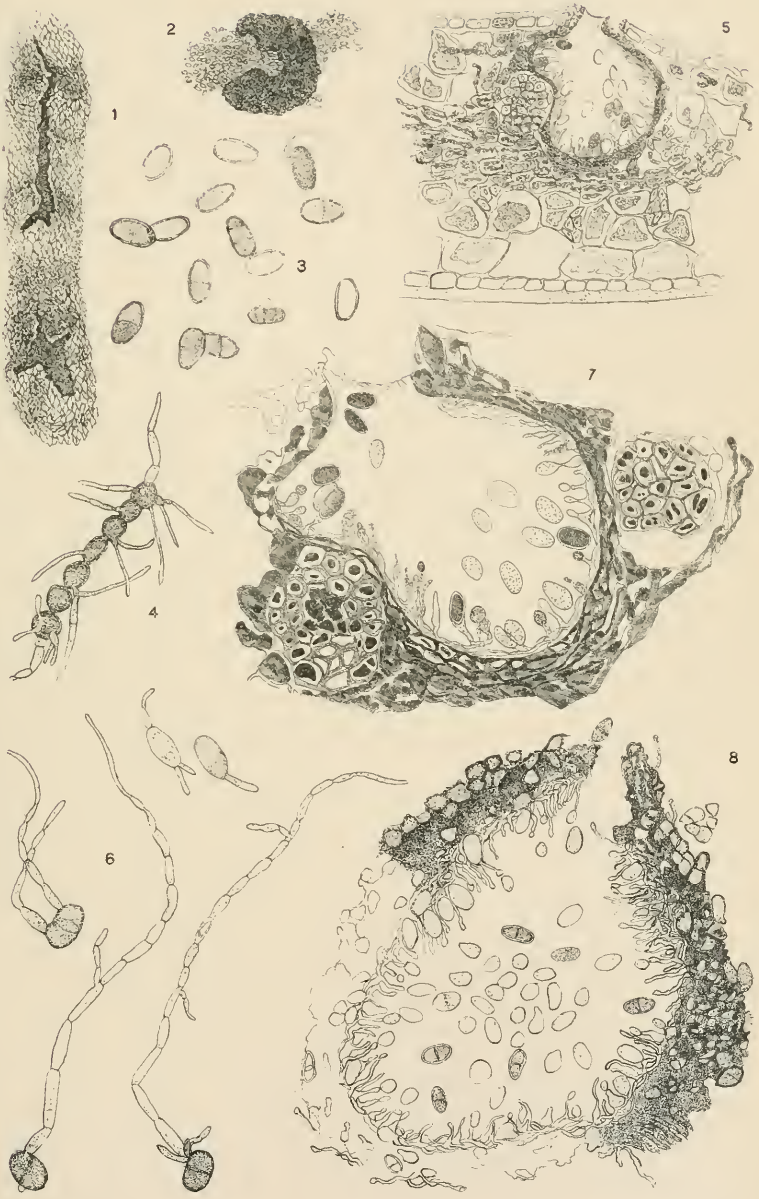
Fig. 5. Longitudinal section through pycnidium in leaf. × 192.

Fig. 6. *Macrophoma* and *Diplodia* spores from a hanging drop culture. 48 hours old. × 280.

Fig. 7. Similar to Fig. 5, more highly magnified and somewhat diagrammatic. × 280.

Fig. 8. Longitudinal section of pycnidium growing above medium. × 280.

Figs. 3, 6 and 7 are drawn with a camera lucida.



MACROPHLOMA AND DIPLODIA

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CONTRIBUTIONS FROM THE NEW YORK BOTANICAL
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STUDIES ON THE ROCKY MOUNTAIN FLORA—XII

By PER AXEL RYDBERG

NEW YORK
1904

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, **31**: 555-575. October, 1904]

[From the Bulletin of the Torrey Botanical Club, 31 : 555–575. Oct , 1904.]

Studies on the Rocky Mountain flora — XII.

Per Axel Rydberg

Draba coloradensis sp. nov.

Annual, leafy below, often branched, 5–10 cm. high ; leaves obovate, entire, 1–2 cm. long, 0.5–1 cm. wide, subsessile, coarsely hirsute, hairs often branched but not truly stellate ; peduncles 5 cm. or in fruit often 10 cm. long ; raceme short and corymbiform at first, more elongated in fruit ; sepals oval or oblong, obtuse, 1.5–1.75 mm. long ; petals white, 3–3.5 mm. long, spatulate, emarginate ; fruiting pedicels 4–5 cm. long, divergent ; pods linear-oblong, 10–12 mm. long and nearly 2 mm. wide, hirsute ; style none.

This species belongs to the *D. caroliniana* group. From that species it differs in the hirsute pods, stouter habit and larger leaves ; from *D. micrantha* in the large petals, the larger leaves and the more elongated raceme in fruit ; and from *D. cuneifolia* in the entire leaves and the larger pods. It grows on river flats, dry hills and plains at an altitude of about 1500 m.

Colorado : Fort Collins, river flats, lower Armstrong, 1897, collector not given (type) ; plains near Denver, 1870, *E. L. Greene* ; Mancos, 1891, *Alice Eastwood.*

Draba streptocarpa Grayana var. nov.

Low and densely cespitose, almost pulvinate ; flowering stems 1–3 cm. high, almost scapose ; stem-leaves few and reduced ; even the basal leaves much smaller than in the type.

It grows at an altitude of 3600–4000 m.

Colorado : Gray's Peak, Aug. 1895, *P. A. Rydberg* (type) ; same locality, 1892, *C. S. Crandall 31* ; mountain west of Como, 1895, *Crandall & Cowan 41.*

Smelowskia lineariloba sp. nov.

Densely cespitose ; caudex densely covered by the bases of the dead leaves ; leaves 2–5 cm. long, pinnately divided to the midrib into linear acute divisions, finely stellate and the petioles ciliate ; stems about 1 cm. high, few-leaved ; inflorescence at first short and corymbiform, in fruit elongated; sepals oblong, pubescent, about 3 mm. long; petals clawed, 5–6 mm. long, white or pink; blades broadly spatulate; fruit 11–12 mm. long and about 1 mm. wide, tapering at both ends.

This species is nearest related to *S. americana*, but differs in the narrow segments of the leaves and the long narrow pod. It grows on high peaks of Colorado at an altitude of 3,600–4,200 m.

COLORADO: Douglass Mountain, 1878, *M. E. Jones 447* (type in herb. Columbia University); Hindsdale Co., 1878, *F. M. Pease;* near Ironton, 1899, *C. C. Curtis.*

Sophia purpurascens sp. nov.

Stem very slender, diffusely branched above, glabrous and purplish; lower leaves not known, having all fallen off; upper leaves simply pinnate with linear-oblong divisions, slightly stellate; racemes slender; sepals broadly oblong, over 1 mm. long, light yellow, almost equaling the similar petals; pedicels ascending in fruit, 4–5 mm. long, 0.75 mm. thick; fruit very slender, 5–8 mm. long, linear, 3–6-seeded, nearly cylindrical and tapering somewhat at both ends, slightly torulose; seeds in one row.

This is perhaps nearest related to *S. incisa* and *S. leptophylla*, but differs in the slender purple stem, the diverging branches above, the slender inflorescence, and slender short pod. It grows in the mountains at an altitude of about 3,300 m.

COLORADO: Red Mountain, south of Ouray, 1901, *Underwood & Selby 275.*

Sophia ramosa sp. nov.

Stems 3–6 dm. high, finely but sparingly stellate, branched, especially above; branches ascending or diverging, forming with the stem an angle of 45° or more; leaves once or twice pinnate, sparingly stellate; divisions linear or linear-oblong; racemes oblong; petals oblanceolate, pale yellow, slightly longer than the sepals; pedicels in fruit 7–8 mm. long, ascending; pod somewhat clavate, 8–10 mm. long, erect or strongly ascending, about 1 mm. thick; seeds in two more or less distinct rows; styles almost none.

This species is perhaps nearest related to *S. intermedia*, but differs in the spreading branching, the smaller and paler petals, and the shorter pedicels and style. It grows in waste ground at an altitude of about 2,750 m.

COLORADO: Pitkin, 1901, *Underwood & Selby 413.*

Arabis oblanceolata sp. nov.

Perennial, somewhat branched at the base, 3 dm. or more high; basal leaves petioled, sparingly stellate-pubescent, 3–10 cm. long; blades oblanceolate, acute, entire; stem-leaves sessile, lanceolate, sagittate-auricled at the base; sepals oblong, acute, 3–4 mm. long, white-hairy near the apex; petals dark reddish-purple, 7–8 mm. long, spatulate with a long claw; pedicels in fruit ascending, about 12 mm. long; pods ascending, about 5 cm. long and 2 mm. wide, glabrous; seeds in 2 rows; style none.

This is perhaps nearest related to *A. Crandallii* Robinson, but is a larger plant, less stellate, with much larger basal leaves and pods, and the flowers are much darker. It grows at an altitude of about 3,000 m.

COLORADO: Valley Spur, 1901, *Underwood & Selby 454*.

Arabis Selbyi sp. nov.

Perennial, with a basal rosette of leaves; basal leaves oblanceolate, 5–10 cm. long, short-petioled, acute, sinuate-denticulate, green but stellate on both sides, not ciliate; stems 4–5 dm. high, branched; stem-leaves linear-lanceolate, sagittate at the base; racemes long and lax; sepals linear, green, obtuse, about 3 mm. long, sparingly stellate; petals red-purple, narrowly oblanceolate, long-clawed; fruiting pedicels 3–4 mm. long, divergent; pods divergent, about 3 cm. long and 2 mm. wide, obtuse at both ends; style obsolete; seeds in 2 rows.

This species is perhaps nearest related to *A. lignifera* and *A. brachycarpa*. From the first it differs in the large, denticulate basal leaves, the stouter branched stem and the narrow dark petals. The latter has hispid ciliate as well as stellate leaves. *A. Selbyi* grows in cañons and neighboring meadows at an altitude of 2,300–2,800 m.

COLORADO: West of Ouray, 1901, *Underwood & Selby 207*.

Erysimum oblanceolatum sp. nov.

Biennial; stem 4–6 dm. high, strigose, rather simple; leaves narrowly oblanceolate, 5–12 cm. long, entire or sinuate dentate; the lower petioled, sparingly strigose; racemes elongated; sepals linear, about 6 mm. long, about equaling the claw of the light yellow petals; blades of the latter broadly spatulate or almost orbicular; the whole length of the petals about 15 mm., fruiting pedicels about 8 mm. long, ascending or spreading; pod tetragonal, ascending, about 8 cm. long, almost straight, not twisted, about 1.5 mm. thick; style about 1 mm. long.

This is intermediate between *E. elatum* and *E. Wheeleri.* The former has longer petals, the claws of which are much longer than the sepals and the leaves are usually more dentate. From *E. Wheeleri* it differs in the light yellow petals. It grows on foothills and plains at an altitude of 1,500–3,000 m.

COLORADO: Georgetown, 1895, *P. A. Rydberg* (type); La Plata P. O., 1898, *Baker, Earle & Tracy 906;* mesas near Pueblo, 1900, *Rydberg & Vreeland 6193;* Williams Cañon, 1894, *E. A. Bessey.*

WYOMING: Buffalo, 1900, *F. Tweedy 3595.*

Erysimum radicatum sp. nov.

Perennial with a tap-root, branched at the base; stems 1.5 dm. or less high, slightly strigose; leaves linear-oblanceolate, sinuately toothed, 4–7 cm. long, strigose; raceme short and dense; sepals fully 1 cm. long, linear, acutish, equaling the claws of the petals; the latter light yellow, about 15 mm. long; blades broadly spatulate, almost orbicular; fruiting pedicels about 8 mm. long, ascending; pods ascending, tetragonal, about 4 cm. long.

This is somewhat related to **Erysimum nivale** (*Cheiranthus nivalis* Greene) but differs in the basal rosettes of sinuate-dentate leaves. It grows at an altitude of about 3,800 m.

COLORADO: Bottomless Pit (Pike's Peak), 1901, *Clements 441* (type); also in 1900 at the same place.

Opulaster bracteatus sp. nov.

A shrub a meter or two high; bark of the stems brownish-gray, more or less flaky; that of the young twigs yellowish-green, glabrous or nearly so; stipules linear-lanceolate, about 5 mm. long, pubescent; petioles 1–3 cm. long; leaf-blades 3–7 cm. long, ovate or cordate in outline, 3–5-lobed and doubly crenate, acute, glabrous or nearly so on both sides, somewhat paler beneath; corymb rather many-flowered; bracts obovate or spatulate, often foliaceous and more or less persistent, pubescent; hypanthium sparingly stellate; sepals oblong-ovate, obtuse or acutish, about 3 mm. long, densely stellate on both sides; petals white, rounded-ovate, 4–5 mm. long; carpels 2, densely stellate, united at least half their length; styles ascending.

This resembles mostly *O. intermedius* in habit and leaves, but has the fruit of *O. monogynus.* It differs however from both in the conspicuous persistent bracts. It grows along streams in the foothills of northern Colorado.

COLORADO: New Windsor, 1898, *G. E. Osterhout 23* (type); also Buckhorn Creek, 1897, and Cheyenne Cañon, 1895; foothills west of Fort Collins, 1893, *C. F. Baker.*

Opulaster glabratus sp. nov.

A shrub about 1 m. high; bark of the stems gray and flaky, that of the old branches dark brown and of the young shoots yellowish or reddish; petioles 1–2 cm. long; leaf-blades rounded-ovate, orbicular or sometimes slightly reniform, 2–3 cm. long, glabrous, slightly paler beneath, 3–5-lobed, obtuse; corymb rather small, glabrous; bracts small, lanceolate, deciduous; hypanthium almost glabrous; sepals oval or rounded-ovate, obtuse, sparingly stellate beneath, densely so above, about 3 mm. long; petals rounded-ovate, about 4 mm. long, pink or white; carpels 2, united to above the middle, densely stellate.

This resembles in habit a small-leaved *O. intermedius*, but is closer related to *O. monogynus*, differing in the larger, less dissected leaves and the less stellate and larger calyx and hypanthium. The type grew at an altitude of between 3,000–3,800 m.

COLORADO: West Spanish Peaks, 1900, *Rydberg & Vreeland 6027* (type); Turkey Creek, *6026;* Rist Canon, 1898 and 1899 (collectors not given).

Holodiscus microphyllus sp. nov.

A low shrub; bark of the stems dark brown; that of the branches light, yellowish or brownish, soft-strigose; leaves spatulate-cuneate, 1–1.5 or rarely 2 cm. long, evenly serrate, with strong nerves beneath, finely strigose or glabrate above, densely soft-pubescent beneath, at first almost white, in age more glabrate; inflorescence small, 3–5 cm. long, its branches short and few-flowered; sepals about 1 mm. long, ovate, as well as the peduncle and pedicels soft-villous; petals broadly obovate, a little exceeding the sepals; hairs of the carpels copious, about equaling the stamens.

This has gone under the name of *H. dumosus*, but the original *Spiraea dumosa* Nutt. is a larger plant with large inflorescence and larger incised or doubly toothed leaves, and apparently the same as *S. discolor* Pursh.

UTAH: Alta, Wahsatch Mountains, 1879, *M. E. Jones 1142* (type in herb. Columbia University); Uintahs, 1869, *S. Watson*

305 in part; Stansbury Island, 1850, *Stansbury;* Southern Utah, 1877, *E. Palmer 136.*

COLORADO: Chicken Creek, 1898, *Baker, Earle & Tracy 863.*

Potentilla Bakeri sp. nov.

Perennial; stem rather stout, about 4 dm. high, rather loosely hirsute, branched; basal leaves usually digitately 7-foliolate; petioles 6–8 cm. long, loosely hirsute; leaflets oblanceolate, 3–5 cm. long, strongly veined, coarsely silky on both sides and slightly grayish tomentose beneath, cleft to about three-fourth to the midrib into oblong acute lobes; stem-leaves similar but smaller and short-petioled, usually only 5-foliolate or the upper 3-foliolate; inflorescence open, usually flat-topped and corymbiform; hypanthium and calyx silky-hirsute and slightly tomentulose; bractlets linear-lanceolate, about 3 mm. long and half as long as the ovate or ovate-lanceolate acuminate sepals; petals obcordate, a little exceeding the sepals; stamens about 20; achenes smooth and shining; style filiform.

In my monograph I included the only specimen then at hand in *P. viridescens,* but it has deeper dissected leaves and more spreading pubescence than that species. Specimens of the present species are found in collections under the name of *P. Blachkeana, P. candida* and *P. flabelliformis.* It can, however, not well be confounded with any of these, except perhaps *P. candida,* which it resembles in general habit and leaf-form. *P. candida* is, however, a small plant with leaves intensely white on both sides. *P. Bakeri* grows at an altitude of 2,100–2,700 m.

COLORADO: Grizzly Creek, 1896, *C. F. Baker* (type); Doyle's, 1901, *647;* banks of Grizzly, 16 miles from Walden, 1894, *Crandall 1224.*

Rosa Underwoodii sp. nov.

Shrub, 1–2 m. high; bark of the old stems gray; that of preceding year's branches purplish and of the new twigs purplish or green; prickles infrastipular and scattered, strongly curved, 7–10 mm. long, with an oblanceolate base, 5–10 mm. long; stipules narrow, the lanceolate free portion about 5 mm. long, glandular-dentate; leaves 5–10 cm. long; petiole and rachis puberulent and with sessile glands; leaflets 2–4 cm. long, obovate or oval, usually obtuse, doubly serrate, glabrous on both sides or finely puberulent and slightly paler beneath; flowers usually solitary;

sepals lanceolate, acuminate, about 2 cm. long, erect and persistent in fruit, tomentulose above, glandular and bristly beneath, often with linear lobes; petals obcordate, about 2.5 cm. long and fully as wide; hip in fruit more or less pear-shaped, about 3 cm. long and 2 cm. in diameter, sparingly bristly.

This species has the general habit of *R. Nutkana* and *R. MacDougalii*, but differs from both in the curved prickles. It has bristly fruit as the latter, but the fruit is more tapering at the base and the bristles fewer. It grows in the mountains at an altitude of 2,300–2,700 m.

COLORADO: Hills about Box Cañon, west of Ouray, 1901, *Underwood & Selby 122* (type) and *113*; La Plata Cañon, 1898, *Baker, Earle & Tracy 860.*

Rosa oreophila sp. nov.

A shrub 2–3 m. high; bark reddish, glossy; prickles mostly infrastipular or lacking, weak, 5 mm. long or less, curved with elliptic bases; stipules broad, finely pubescent and glandular-denticulate on the margin; free portion ovate, 5–15 mm. long; leaves 7–10 cm. long, 5–7-foliolate; rachis and petiole finely pubescent and with sessile glands; leaflets 2–3.5 mm. long, ovate or oval, acute or obtuse, glabrous and dark green above, sparingly and finely pubescent and paler beneath, coarsely serrate; flowers mostly solitary; sepals narrowly lanceolate, acuminate, finely pubescent on both sides and glandular-denticulate on the margins, erect and persistent in fruit; petals obcordate, 2–2.5 cm. long; hip glabrous, when ripe fully 2 cm. long, often acute at the base.

This is perhaps nearest related to the preceding, but differs in the smooth and more rounded fruit and more slender prickles. It grows at an altitude of 2,300–2,500 m.

COLORADO: Four-miles Hill, Routt Co., 1896, *Baker* (type); Dix P. O., 1898, *Baker, Earle & Tracy 474*; Box Cañon, Ouray, 1901, *Underwood & Selby 121a* and *b.*

Astragalus oreophilus sp. nov.

Erect perennial, 3–6 dm. high; stem sparingly strigose, branched with almost erect branches; leaves about 15 cm. long, with 7–23 leaflets; stipules triangular to lanceolate, strigose, acuminate, free from the petioles but more or less united with each other across the back of the stem; petioles 2–4 cm. long; leaflets oblong or elliptic, about 3 cm. long, strigose on both sides, glabrate above; peduncles 0.5–1.5 dm. long; inflorescence racemose, 5–10 cm. long; bracts lanceolate, acuminate, 3–5 mm. long; pedicels very short; calyx-tube nearly cylindric, about 5 mm. long, gibbous above, white-pubescent with short hairs; lower calyx-teeth subulate, about 1.5 mm. long; the upper lanceolate, shorter and slightly broader; pod oblong, about 1.5 cm. long and 5 mm. thick, often sparingly hairy when young, in age glabrous, almost terete, leathery, completely 2-celled.

This species has been confounded with *A. Mortonii* and sometimes with *A. canadensis.* The former is found only in the Columbia Valley region and is characterized by the intermixed black hairs on the calyx, and by the more hairy pod which is distinctly sulcate on the lower suture. *A. oreophilus* is really closer related to *A. canadensis*, but differs principally in the short bracts and calyx-teeth. In *A. canadensis* the bracts are linear-lanceolate, long-attenuate, the lower almost as long as the calyx, and the calyx-teeth longer, fully half as long as the tube. *A. oreophilus* grows in the foot hills at an altitude of 1,500–2,200 m.

COLORADO: Pagosa Springs, 1899, *C. F. Baker 419* (type); near Boulder, 1902, *F. Tweedy 5154;* Stone Prairie, Larimer Co., 1897, *G. E. Osterhout;* Wahatoya Creek, 1900, *Rydberg & Vreeland 5990;* Durango, 1898, *Baker, Earle & Tracy 478.*

Astragalus Shearii sp. nov

Perennials with horizontal rootstock; stems slender, strigose and striate, about 2 dm. high; stipules triangular, strigose, free from the petioles, but slightly united across the back of the stem; leaves 3–5 cm. long with 13–19 leaflets; these 5–8 mm. long, oblong, obtuse or retuse at the apex, glabrate above, grayish strigose beneath; peduncles 4–5 cm. long; raceme short, 5–10-flowered; calyx-tube campanulate, about 4 mm. long, strigose, partly with black hairs; teeth triangular; corolla reddish-purple, nearly 1 cm. long; pod oblong, 12–14 mm. long, glabrous, reticulate, sessile, almost terete in cross-section; the lower suture intruded and forming a narrow partial partition.

In general habit somewhat resembling *A. Hallii* and *A. flexuosus*, but the structure of the pod places it nearest to *A. elegans.*

COLORADO: Twin Lakes, 1896, *C. L. Shear 3317.*

Homalobus Wolfii sp. nov.

Low depressed cespitose perennial; stems intricately branched, less than 1 dm. long, covered by the scarious, strongly-veined, hirsute-strigose triangular stipules; leaves pinnate with 5 approximate leaflets; these 3–4 mm. long, lanceolate, strongly conduplicate, grayish hirsute, spine-tipped; racemes 1–2-flowered, very short-peduncled in the axils of the leaves; calyx-tube scarcely 2 mm. long, grayish strigose; teeth subulate, about 1 mm. long; corolla ochroleucous, about 4 mm. long.

A species related to and confounded with *H. tegetarius* (*Astragalus tegetarius* S. Wats.), but the latter is a larger plant, has long-peduncled raceme exceeding the leaves, and longer calyx teeth, which about equal the tube in length.

COLORADO: South Park, 1873, *John Wolf 243* (type in herb. Columbia University).

Homalobus Clementis sp. nov.

Perennial, slightly branched, erect or ascending; stem glabrate or slightly strigose, about 2 dm. high; stipules broadly triangular, strigose, abruptly acuminate, more or less united across the back; leaves 5–7 cm. long, with 11–21 leaflets; these oblong or lanceolate, acute, 7–12 mm. long, glabrous above and sparingly strigose beneath; inflorescence 7–10 cm. long, 8–12-flowered; bracts lanceolate, small; flowers very short-pediceled; calyx-tube campanulate, about 3 mm. long, strigose with black hairs, teeth lanceolate-subulate, about half as long; corolla bluish-purple, about 8 mm. long; pod oblong, latterally compressed, sessile, about 1 cm. long, 3–4 mm. wide, black-hairy with very short hairs; both sutures prominent, the upper almost straight.

This species is perhaps closest related to **Homalobus wingatensis** (*A. wingatensis*); but that species is grayish canescent and has a glabrous pod. *H. Clementis* grows at an altitude of 2,500–3,000 m.

COLORADO: Sangre de Cristo, 1896, *F. Clements 354* (type); Marshall Pass, 1901, *C. F. Baker 489*.

Homalobus decurrens sp. nov.

Perennial with a rootstock, somewhat cespitose; stems erect, 3–4 dm. high, slightly strigose and angled, stipules lanceolate, free, about 5 mm. long, strigose; leaves 1–1.5 dm. long with 11–15 leaflets; these 2–4 cm. long, linear-oblong to oblanceolate, sparingly strigose or glabrate above; the terminal one usually larger, more or less decurrent on the rachis and without a definite node; racemes slender, 1–1.5 dm. long, lax, 5–10-flowered; bracts subulate; calyx-tube campanulate, about 2.5 mm. long, more or less black-hairy; teeth nearly 2 mm. long and subulate; pod fully 2 cm. long and 3 mm. wide, sessile, linear, straight, glabrous.

This species is nearest related to *H. campestris* and *H. hylophilus;* but differs from both in the peculiarities of the terminal leaflets. It has broader and less hairy leaflets than the former and narrower and longer than the latter. It grows on hillsides.

COLORADO: Estes Park, 1895, *G. E. Osterhout* (type); also in 1900; Gray-Back Mining Camps, 1900, *Rydberg & Vreeland 5960.*

Ceanothus subsericeus sp. nov.

A small shrub, apparently not spiny; bark of the stems gray or brown; of the twigs light gray and finely pubescent; leaves short-petioled; petioles 3–6 mm. long; blades elliptic or elliptic-lanceolate, acute at both ends, 2–3 cm. long, more or less glandular-denticulate, 3-ribbed, sparingly strigose above, grayish-silky beneath; umbels axillary and terminal; peduncles 3–10 mm. long; pedicels 5–10 mm.; calyx about 3 mm. in diameter; sepals semi-orbicular; petals white, broadly spatulate, clawed, 1–5 mm. long; fruit dark brown, about 4 mm. in diameter, slightly 3-lobed above.

This species is intermediate between *C. ovalis pubescens* and *C. Fendleri.* In habit it resembles most the latter, but differs in the denticulate leaves and in not being spiny. From the former in the smaller size, the silky, instead of villous, pubescence and the principally axillary umbels. *C. subsericeus* grows in the foothills at an altitude of about 1,800 m.

COLORADO: Larimer Co., 1895, *J. H. Cowen* (type); "Colorado," 1874, *G. C. Woolson.*

Sphaeralcea Crandallii sp. nov.

Perennial, about 6 dm. high; stem simple, sparingly stellate; petioles 3–4 dm. long; leaf-blades cordate in outline, 5-lobed, about 5 cm. in diameter; lobes lanceolate, coarsely toothed; inflorescence mostly terminal; pedicels and calyx sparingly and finely stellate; bractlets subulate, nearly equaling the lanceolate long-attenuate sepals; petals white or nearly so, about 2.5 cm. long, cuneate and slightly emarginate; fruit not known.

This resembles a small *S. rivularis*, but differs in the long bractlets and the lanceolate sepals. It grows at an altitude of about 2,000 m.

COLORADO: Steamboat Springs, 1894, *Crandall 97.*

Sphaeralcea grandiflora sp. nov.

A meter or two high; stem glabrous below, stellate above; petioles of the lower leaves 1–2 dm. long; blades cordate or reniform in outline, maple-like, 9–15 cm. wide, deeply 5–7-lobed; lobes lanceolate or triangular, coarsely toothed with triangular teeth; flowers in small axillary clusters, but at the end of the stem the subtending leaves become diminished and the inflorescence resembles a congested panicle; pedicels and calyx densely hirsute-pubescent with long stellate hairs, the branches of which are 1–2 mm. long; bractlets lanceolate, about half as long as the triangular-ovate, acute or somewhat acuminate sepals; petals pinkish, 3 cm. or more long; fruit spherical, and deeply retuse at the apex; carpels membranous, smooth on the sides and bristly on the back, rounded at the apex; seeds reniform, brown, muricate.

A close ally of *S. rivularis*, but differs in the larger flowers, the broader bractlets, the long hairs of the calyx, the usually blunter leaves and more rounded carpels. It grows at an altitude of 2,200–2,800 m.

COLORADO: Mesa Verde, 1901, *F. K. Vreeland 882* (type); west of Ouray, 1901, *Underwood & Selby 1904* (in fruit).

Touterea laciniata sp. nov.

Biennial or short-lived perennial; stems 3–4 dm. high, white, puberulent, strict, in age branched; leaves narrowly lanceolate in outline, 5–10 cm. long, deeply pinnatifid to near the midrib; sinuses rounded or nearly semi-rhombic; lobes oblong to lanceolate, obtuse: flowers usually bracted by 1–2 laciniate bracts; sepals about 1 cm. long, lanceolate with a subulate tip, soon reflexed; petals golden yellow 15–20 mm. long, short-clawed; blades oblanceolate, acute; staminodia similar and imitating another set of petals; filaments nearly filiform, ¾ as long as the petals.

This species is closely related to *T. speciosa*, but differs in the deeply dissected leaves and more slender stem. In general habit it resembles somewhat *T. multiflora*, for which it has been mistaken; but that species has broader, obtuse petals, more dilated filaments, and more diverging branches. *T. laciniata* grows on dry hillsides at an altitude of 1,500–2,200 m.

COLORADO: Pagosa Springs, 1899, *Baker 470* (type); Durango, 1898, *Baker, Earle & Tracy 496;* Cañon City, 1900, *Osterhout;* Antonito, 1898, *Earle.*

Touterea sinuata sp. nov.

A decumbent biennial, 3–4 dm. high; stems stout, white, pubescent, much branched; lower leaves 10–15 cm. long, lanceolate or oblanceolate, tapering at the base, sinuately lobed or dentate; lobes or teeth broadly triangular, but often obtusish; upper leaves broadly lanceolate, or even ovate, sessile and cuneate or rounded at the base; flowers numerous, usually with 1–2 linear bracts; sepals lanceolate, tapering into a subulate tip, soon reflexed, about 8 mm. long; petals golden yellow, 15–20 mm. long; oblanceolate, acute; staminodia similar; filament slightly dilated; capsule 2.5–3 cm. long, 7–8 mm. thick; seeds winged, about 3 mm.

This species is also a close relative of *T. speciosa*, differing in the decumbent, branched habit and the broad leaves. The type grew in a cañon at an altitude of about 1,800 m.

COLORADO: Boulder, 1895, *Rydberg*.

Acrolasia gracilis sp. nov.

Annual, 3–5 dm. high, at first simple, but later branching; leaves 5–10 cm. long, deeply pinnatifid to near the midrib; rachis and lobes 2–3 mm. wide; the latter oblong or lanceolate, obtuse; floral leaves lanceolate, sessile, pinnatifid or toothed, rarely entire; sepals lanceolate, 4–5 mm. long; petals obovate, 6–7 mm. long, strongly striate; capsule sessile, linear-cylindric, 2.5–3 cm. long and about 2 mm. thick; seeds more or less prismatic, muricate.

This is Nuttall's *Trachyphytum gracile*, a specimen of which is in the Columbia University herbarium. The species was never published, however. The name appears only as a synonym under *Mentzelia albicaulis* in Torrey and Gray's Flora, 1: 534. I think, however, that it is well distinct from *A. albicaulis* or *Bartonia albicaulis* Hook. The latter is characterized by the smaller petals, only 3–4 mm. long; the middle and upper leaves are often entire or with an entire lower and upper portion and only with a few lobes in the middle. In Hooker's type specimen the leaf-lobes are very few and Urban and Gilg confused it with *A. integrifolia*, claiming that *Mentzelia dispersa* Wats. (which is the same as *A. integrifolia*) is the typical form of *Mentzelia albicaulis*. *A. integrifolia* (Wats.) Rydb. and *A. compacta* (A. Nels.) Rydb. are, however, easily distinguished from the other species by the short linear-oblong, obtuse sepals, only 1/3 as long as the petals, and by the seeds, which are apparently smooth, the fine murication being seen only under a strong lens. *A. gracilis* grows in sandy soil, on hillsides and in river bottoms at an altitude of 1,500–2,500 m.

COLORADO: Foothills, Larimer County, 1895, *J. H. Cowen* (type); Ridge below Tobe Miller's, *Cowen;* Salida, 1898, *Baker, Earle & Tracy 14* (in part); mesas near Pueblo, 1900, *Rydberg & Vreeland 5865.*

WYOMING: Fort Steele, 1901, *Tweedy 4573* and *4574.*

IDAHO: Common, 1892, *Isabel Mulford.*

"OREGON": Nuttall's specimens of *Trachyphytum gracile.*

Acrolasia latifolia sp. nov.

Stout annual, 3–5 dm. high, branched; leaves sessile, ovate or ovate-lanceolate, coarsely toothed or entire, 5–10 cm. long, 2–3 cm. wide; sepals lanceolate, 2.5–3 mm. long; petals obovate-spatulate, about 5 mm. long; capsule linear, cylindric, 2.5–3 cm. long, about 2.5 mm. thick, sessile; seeds prismatic, muriculate.

This has been mistaken for *A. integrifolia* on account of its broad, merely toothed leaves, but the sepals and seeds place it in the *A. albicaulis* group and nearest the preceding and *A. ctenophora.* It grows on hills at an altitude of 1,200–2,400 m.

COLORADO: Mountains between Sunshine and Ward, 1902, *Tweedy 5149* (type); Boulder, 1901, *Osterhout 2471;* Larimer County, 1895, *Cowen.*

Epilobium ovatifolium sp. nov.

Plant 2–6 dm. high, propagating by turions; stem glabrous except the decurrent lines which are more or less crisp-hairy, especially above; leaves sessile or nearly so, ovate or ovate-lanceolate and acute, or the lowest oval and obtuse, 3–4 cm. long, entire or denticulate, glabrous; petals purple or rarely rose, 5–7 mm. long; pods 5–6 cm. long, 1.5–2 mm. in diameter, sessile, more or less crisp and glandular hairy; seed a little over 1 mm. long, abruptly contracted above, but without neck; coma white, about 6 mm. long.

The type specimens are labeled *E. Hornemannii* Reichenb. which it resembles somewhat in general habit; but that species propagates in an altogether different way and the leaves are more or less petioled. The present species is more closely related to *E. brevistylum* and *E. glandulosum.* It differs from the former mainly in the seeds, which lack the hyaline neck characteristic of that species. From *E. glandulosum* it is separated by the smaller size of the plant and of the flower, and by the light green leaves, which lack the coarse toothing of that species. It may also be confused with *E. adenocaulon*, but that species has smaller and lighter flowers, propagates by leafy rosettes and has usually distinct although short petioles. *E. ovatifolium* grows in wet places, especially in springs, in the mountains of Colorado and Utah at an altitude of 2,300–3,800 m.

COLORADO: Near Empire, 1892, *Patterson 205* (type); Red Mountain, 1901, *Underwood & Selby 297;* Bob Creek, 1898, *Baker, Earle & Tracy 855;* Ironton Park, 1901, *Underwood & Selby 303b;* Columbine, 1901, *Tweedy 4429*; headwaters of Sangre de Cristo Creek, 1900, *Rydberg & Vreeland 5847.*

UTAH: "Southern Utah," 1877, *Palmer 155.*

Epilobium rubescens sp. nov.

Stem 3–4 dm. high, strict and simple, often more or less reddish, glabrous below, crisp-hairy above and more or less on the decurrent lines; leaves 3–4 cm. long, perfectly sessile, lanceolate, rounded at the base, denticulate, very acute, slightly crisp-hairy beneath when young; petals white, about 4 mm. long; pods 4–5 cm. long and 1.5 mm. thick, more or less crisp-pubescent; seeds without neck, brownish, smooth, about 1 mm. long; coma white, 5–6 mm. long.

This species is perhaps most closely related to *E. adenocaulon*, but differs in the perfectly sessile leaves and simpler habit. It grows in wet places up to an altitude of 2,700 m.

COLORADO: Pagosa Springs, 1899, *Baker* (type); Middle Park, 1892, *Beardslee.*

Epilobium stramineum sp. nov.

Stem 5–6 dm. high, simple, light and more or less straw-colored, glabrous below, more or less pubescent and somewhat glandular in the inflorescence; leaves sessile, light green, lanceolate, tapering at both ends, denticulate, 4–5 cm. long, 1–1.5 cm. wide, very acute; petals white, 4–5 mm. long; pod 4–5 cm. long and 1 mm. wide, more or less crisp and glandular; seeds light-brown, without a neck; coma white.

This has been taken for *E. Drummondii*, but the type of that species has narrow, almost linear leaves, and is seldom over 3 dm.

high. *E. stramineum* grows at an altitude of 2,400–3,200 m. in the mountains of Colorado, while the range of *E. Drummondii* extends further north.

COLORADO: Idaho Springs, 1905, *Rydberg* (type); Pagosa Peak, 1899, *Baker 487;* Sangre de Cristo Creek, 1900, *Rydberg & Bessey 5848;* Chicken Creek, 1898, *Baker, Earle & Tracy 341.*

Epilobium Palmeri sp. nov.

Perennials propagating by turions or occasionally with more leafy rosettes; stem 4–6 dm. high, branched, glandular pilose, nearly terete, usually reddish or brownish; leaves sessile or nearly so, ovate or ovate-lanceolate, rounded or obtuse at the base, acute, denticulate, 3–4 cm. long, more or less pubescent; petals pink or light purple, about 5 mm. long; pod 4–6 cm. long, 1.5 mm. thick; seeds brown, more or less papillose, without a beak; coma white or in age somewhat tawny, 6–8 mm. long.

The type was named *E. tetragonum* L., which species is not found in the United States. It resembles much *E. brevistylum* and *E. ovatifolium* in habit, but is characterized by the pubescent stem and leaves.

UTAH: "South Utah," *E. Palmer 156* (type in herb. Columbia University).

IDAHO: Moscow, 1900, *L. R. Abrams 848.*

MONTANA: Camp Glazier, 1901, *Umbach 327.*

COLORADO: Tobe Miller's Ranch, 1897, *A. Fry.*

Gayophytum intermedium sp. nov.

Profusely branched glabrous annual; stem white and shining, with more or less peeling bark, 3–7 dm. high, erect; leaves linear or nearly so, light green; sepals about 1.5 mm. long, soon spreading or reflexed, yellowish; petals 1.5–2.5 mm. long, rose with yellow base; capsule 8–12 mm. long, nearly twice as long as the reflexed pedicel, somewhat clavate and torulose, somewhat strigose when young; seeds 1.75 mm. long, glabrous.

This species is intermediate between *E. diffusum* and *E. ramosissimum* in some respects. The flowers approach the latter more in size but the former in coloration. The pod is comparatively longer than in either. In both it is scarcely longer than the pedicels. *E. intermedium* grows in sandy soils in Colorado at an altitude of 1,500–3,000 m.

COLORADO: Ouray, 1901, *Underwood & Selby 193* (type); mountains between Sunshine and Ward, 1902, *Tweedy 5092*; near Boulder, *5091*; Chamber's Lake, 1899, and 1896, *Baker*; Veta Pass, 1900, *Rydberg & Vreeland 5860*; Ward, 1901, *Osterhout 2460*; Caribou, 1891, *Penard 122*; Empire, 1892, *Patterson 208*.

WYOMING: West De Lacy's Creek, 1899, *Aven & Elias Nelson*; Headwaters of Clear Creek and Crazy Woman River, 1900, *Tweedy 3640*; Dayton, 1899, *Tweedy 2609*; Biscuit Geyser Basin, 1897, *Rydberg & Bessey 4578*.

Anogra cinerea sp. nov.

Branched perennial, stem 3–4 dm. high, whitish, cinereous, strigose when young; leaves lanceolate to ovate-lanceolate, mostly subsessile, 3–5 cm. long, sinuate-dentate or denticulate, cinereous; calyx glabrous or sparingly long-hairy, acuminate; tips free and rather long; petals 15–18 mm. long; pods divergent at right angles to the stem, 3–3.5 cm. long, almost straight.

This species is nearest related to **Anogra latifolia** (*Oenothera pallida latifolia* Rydb.), but differs in the almost glabrous not cinereous calyx and the narrower leaves.

COLORADO: Between Bent's Fort and Pueblo, 1885, *Fremont 234* (type in herb. Columbia University); Denver, 1895, *Pammel 202*.

SOUTH DAKOTA: Banks of Cheyenne River, 1891, *T. A. Williams.*

WYOMING: St. Antony, 1901, *Merrill & Wilcox 876* (this with more hairy calyx).

Anogra Vreelandii sp. nov.

Perennial; stem erect, strict, 3–5 dm. high, white and shining; leaves narrowly lanceolate, about 5 cm. long, short-petioled or the upper sessile, glabrous, except occasionally strigose-ciliate on the margins, sinuate-dentate; calyx sparingly hairy, acute; the tips free but very short; petals about 2 cm. long, obcordate, white turning pink; pod cylindric, divergent at right angles or reflexed, usually somewhat curved upwards.

The species is a close relative of *A. pallida*, but differs in the silky hairy calyx, the very short calyx-tips and the darker green foliage. It grows at an altitude of about 1800 m.

COLORADO: McElmo Cañon, 1901, *Vreeland 861.*

Pachylophus hirsutus sp. nov.

Cespitose, almost acaulescent perennial; leaves oblanceolate in outline, 1–2 dm. long, more or less petioled, runcinate-pinnately lobed or divided, hirsute-villous, especially on the margins and the veins; teeth or lobes acute; hypanthium 8–12 cm. long, slender, widening upward, conspicuously hirsute, at the throat 1–1.5 cm. wide; sepals lanceolate, 3–4 cm. long, soon reflexed; petals obcordate, 3–4 cm. long; pod 4–5 cm. long, lance-ovoid, about 1 cm. in diameter, sessile; ridges low and rounded, slightly if at all tubercled.

In general habit, this species resembles most *P. macroglottis* and *P. marginatus*. From the former it differs in the hairy hypanthium and calyx, the more hairy leaves and the longer and less tubercled fruit. From the latter it is distinguished by the sessile pod and always subacaulescent habit. *P. hirsutus* grows at an altitude of 2,200–3,000 m.

COLORADO: Georgetown, 1895, *Rydberg* (type); mountains between Sunshine and Ward, 1902, *Tweedy 5094;* South Park, 1872, *Wolf 132;* Ruxton, 1896, *Clements 213;* Pike's Peak, 1896, *Shear 3713;* Mancos, 1898, *Baker, Earle & Tracy 141,* Georgetown, 1885, *Patterson;* vicinity of Como, 1895, *Cowen;* also 1896, *Shear 4576;* Empire, 1893, *Bethel;* Como, 1895, *Crandall 8;* Pennock, 1896, *Crandall 10.*

UTAH: Salt Lake City, 1880, *M. E. Jones 1746;* Diamond Valley, 1902, *Gooding 840.*

Pachylophus caulescens sp. nov.

More or less caulescent perennial; stem 1–2 dm. high, angled, leaves with the long petioles about 2 dm. long; blades lanceolate or ovate-lanceolate, about 3 cm. wide, pubescent on the margins and veins, sinuately dentate with a few lobes on the petiole; hypanthium about 9 cm. long, glabrous, at the throat nearly 1.5 cm. wide; petals about 2.5 cm. long, obovate; pod sessile, about 3 cm. long, lance-ovoid with rounded low ridges.

In habit the species resembles *P. eximius*, but that species has a hirsute hypanthium and calyx and the ridges of the fruit with almost foliaceous crests.

COLORADO: Palisades, 1894, *Crandall 12* (type in herb. Columbia University).

Gaura coloradensis sp. nov.

Herbaceous, biennial or perennial with fusiform root; stem 5–7 dm. high, strict, but somewhat branched, finely strigose, more or less red; leaf-blades narrowly oblanceolate, 5–10 cm. long, gradually tapering below into a short petiole, or the upper sessile, callous-denticulate, finely strigose; inflorescence slender and rather lax, 1.5–2 dm. long; hypanthium about 2 cm. long, finely strigose; sepals about 1 cm., linear-lanceolate, reflexed; petals about 8 mm. long, spatulate, pink, short-clawed; filaments about equaling the petals; anthers brown, about 4 mm. long; fruit 8–10 mm. long, fusiform, 4-angled, tapering below into a short and rather slender stipe-like base.

In habitat and pubescence this species resembles most *G. Pitcheri*, but the leaves are oblanceolate instead of lanceolate and the fruit is that of *G. sinuata*. *G. coloradensis* grows in meadows at an altitude of about 1,500 m.

COLORADO: Fort Collins, 1895, *Cowen* (type); east of College, 1897, *Crandall 1308;* east of Poudre, 1895, *Cowen 1632.*

Suida interior sp. nov.

Cornus Baileyi Coult. & Evans, Bot. Gaz. **15**: 37, in part. 1890.

A shrub 2–5 m. high; bark of the old stems grayish, of the young shoots brownish; young shoots, petioles and inflorescence densely pubescent with short villous hairs; leaves elliptic or oval, acute at both ends, 5–9 cm. long, finely short-strigose on both sides and more or less villous on the veins and in their angles beneath; hypanthium strigose; sepals minute, about 0.5 mm. long or less; petals linear-lanceolate, about 4 mm. long; fruit white, about 5 mm. in diameter; stone elliptic, slightly oblique, longer than broad, nearly smooth.

This species was included in the original description of *Cornus Baileyi*, but is quite different from the type thereof from the lake-shores of Michigan. This has conspicuous sepals and has a more flattened stone, channeled on the edge and with square shoulders. In reality, *S. interior* is much more closely related to **S. stolonifera** (*Cornus stolonifera* Michx.), especially the western variety described below, but differs in the villous pubescent instead of sparingly strigose twigs and inflorescence. In *S. stolonifera* and its variety the stone is usually broader than long and very oblique. *S. interior* grows on river banks west of Mississippi River.

NEBRASKA: Dismal River, 1893, *Rydberg 1414* (type); St. James, 1893, *Clements 2626;* Pine Ridge, 1889, *Webber;* Cedar Island, 1854, *Hayden.*

SOUTH DAKOTA: Piedmont and Little Elk Creek, 1892, *Rydberg 735;* Cobbs Creek, 1894, *T. A. Williams.*

COLORADO: Merker, 1902, *Osterhout 2602;* Walsenburg, 1896, *Shear 4774;* Cañon City, 1896, *Clements 101.*

WYOMING: Dayton, 1899, *Tweedy 2631* and *2632.*

Suida stolonifera riparia var. nov.

Leaves usually oval or elliptic, acute, thinner, lighter green and less pale beneath than in the eastern type; bark on young twigs brownish; sepals and fruit smaller.

In the field this variety looks very unlike the eastern *S. stolonifera.* It grows as a high bush on river banks and is as far as I know not stoloniferous. In the eastern plant the leaves are comparatively thick, darker green above and very pale beneath, and the young shoots bright red. The plant of the interior may represent a distinct species, but on account of the lack of good diagnostic characters it is perhaps better to regard it at present as a variety of the eastern plant. The variety is the only form found in the region of the Rockies and the Great Plains. It is common from Manitoba, the Mackenzie River, to Alaska and south to Nebraska, Colorado and Arizona; as the type may be designated:

COLORADO: Crystal Creek, 1901, *Baker 257.*

Aletes obovata sp. nov.

Cespitose, glabrous, acaulescent perennial with deep tap-root; leaves 1–2 dm. long, pinnate with 4–5 pairs of leaflets; these broadly obovate, 1–2 cm. long, more or less cleft and toothed with short ovate teeth, strongly veined beneath; scapes 1–3 dm. high, round-angled and striate; bracts none; branches of the umbel 2–2.5 cm. long in fruit; bractlets lanceolate, 3–4 mm. long, reflexed in age; pedicels very short or obsolete; flowers yellow; calyx-teeth prominent, in fruit .5–.75 mm. long; fruit 5–6 mm. long and 1.5 mm. in diameter; ribs rather thick; oil-tubes 1 in the intervals, 2 on the commissure, rather large; seed-face only slightly concave.

This species has been confused with the closely related *A. acaulis*, which is easily distinguished by its rhombic, deeply cut leaflets with lanceolate, acuminate lobes and smaller fruit about 4 mm. long.

COLORADO: Near Morrison, 1889, *Greene* (type, in mature fruit, in herb. Columbia University); Golden, 1892, *Crandall* (in flower); Lower Boulder Cañon, 1901, *Osterhout 2433* (in young fruit).

Phellopterus camporum sp. nov.

Perennial with a deep-seated thick tap-root; leaves twice to thrice pinnatifid, petioled, pale-green; petioles 4–7 cm. long; ultimate divisions oblong, obtusish, 3–6 mm. long; peduncles 5–20 cm. long, usually exceeding the leaves; involucres of white hyaline bracts; branches of umbel about 2 cm. long in fruit; bractlets orbicular, 5–7 mm. long, with greenish center and broad white hyaline border, 7–13 nerved; pedicels short, in fruit only 3–5 mm. long; flowers white; fruit with the very broad wings 10–13 mm. long and 9–11 mm. wide; oil-tubes 3–4 in the intervals, 6–7 on the commissure; seed flattened with broadly concave face.

The specimens has been determined as *P. purpurascens Eastwoodiae*, but it is evidently well distinct from that as shown by a duplicate of the type in the herbarium of the N. Y. Botanical Garden; the bractlets are larger and many-nerved, the flowers white and the fruit is longer than in the variety mentioned. It grows on dry mesas at an altitude of 1,500–16,00 m.

COLORADO: Pueblo, 1900, *Rydberg & Vreeland 5825* (type, in flower) and *5824* (in fruit).

Pseudocymopterus montanus mutifidus var. nov.

Low, about 2 dm. high; lower leaflets broadly rhombic in outline, thrice pinnate; the upper twice pinnate; ultimate divisions linear; fruit smaller and more rounded.

On high mountains, at an altitude of 2,700–3,600 m.

NEW MEXICO: Range between Sapello and Pecos rivers, 1900, *Cockerell.*

COLORADO: Ironton, 1899, *C. C. Curtis;* Cumberland Basin, 1898, *Baker, Earle & Tracy 619;* West Indian Creek, 1900, *Rydberg & Vreeland 5798;* Ironton Park, *Underwood & Selby 358.*

Pseudocymopterus aletifolius sp. nov.

Densely cespitose acaulescent glabrous perennial with a very thick root and short caudex, covered by the broad striate bases of dead leaves; leaves once or twice pinnate, dark green, glabrous, stiff and shining, 1–2 dm. long; petioles about equaling the blades, striate; leaf-segments obovate to rhombic-cuneate, deeply cleft; lobes usually 3-toothed with lanceolate acuminate teeth; scapes 1–1.5 dm. long; involucres lacking; branches of the umbel very unequal, in fruit 1–5 cm. long; bractlets linear-subulate, 4–5 mm. long; pedicels also very unequal, in fruit 1–8 mm. long; sepals conspicuous, in fruit 1–2 mm. long; flowers yellow; fruit 5–6 mm. long, 2.5–3 mm. wide; lateral wings evident but rather narrow; dorsal ribs acute or slightly winged; seed flattened and with somewhat concave face; oil-tubes usually solitary in the intervals.

This species is evidently most closely related to *P. anisatus*, but easily distinguished by the very unequal branches of the umbel, the longer, usually less winged fruit and especially by the leaves, which (although much firmer) resemble closely those of *Aletes acaulis.* The plant evidently connects the two genera *Aletes* and *Pseudocymopterus.* The fruit of the present species is also intermediate between *A. acaulis* and *P. anisatus*, and were it not for the flatness of the seed and the lateral wings of the fruit, it might have been referred to *Aletes.* It grows in the mountains of which Pike's Peak is the center, at an altitude of 2,000–2,600 m.

COLORADO: Minnehaha, 1901, *Clements 94* (type); same locality, 1895, *E. A. Bessey;* North Cheyenne Cañon, 1895, *E. A. Bessey*, and 1892, *C. S. Sheldon;* South Cheyenne Cañon, 1900, *Rydberg & Vreeland 5815;* Cheyenne Mountain, 1892, *Alice Eastwood;* Manitou, 1900, *Clements;* Ruxton, 1896, *Clements 211;* Halfway House, 1896, *Shear 3709* (Rydberg & Vreeland's specimens are in flower, the others in fruit).

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THE POLYPORACEAE OF NORTH AMERICA—IX.

IONOTUS, SESIA AND MONOTYPIC GENERA

By WILLIAM A. MURRILL

NEW YORK
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The Polyporaceae of North America — IX. Inonotus, Sesia and monotypic genera

WILLIAM A. MURRILL

Continuing the work begun in article VIII of this series upon colored sessile forms, an attempt is here made to treat in their proper relations plants with brown context and spores, constituting the genus *Inonotus*, and plants with brown context, hyaline spores and daedaleoid or lamelloid tubes, constituting the genus *Sesia*. A few genera are also added that contain only a single species each.

INONOTUS Karst. Medd. Soc. Faun. et Fl. Fenn. 5: 39. 1879

Inoderma Karst. Medd. Soc. Faun. et Fl. Fenn. 5: 39. 1879.
Inodermus Quél. Ench. 173. 1886.

This genus was based upon four species, *I. cuticularis* (Bull.), *I. hispidus* (Bull.), *I. unicolor* (Schw.) and *I. hypococcinus* (Berk.). The two last can hardly be considered congeners of the first. The type species is *I. cuticularis*, not found in America. Karsten in later publications included also *I. fibrillosus*, *I. vulpinus*, *I. triqueter*, *I. radiatus* and *I. nidulans* in the genus, although some of them have hyaline spores. These he divided into two groups, one in which the pileus is spongy-fleshy and anoderm and the other containing species with a dry, thin, fibrous cuticle. To the first group, such species as *I. cuticularis* and *I. hispidus* belonged, while *I. radiatus* and *I. fibrillosus* were in the second group.

This second group at first constituted the genus *Inoderma* of Karsten, but the name is untenable, because preoccupied by *Inoderma* of S. F. Gray for a genus of lichens. Quélet's genus *Inodermus* was not only preoccupied so far as the name was concerned, but was founded upon *I. hispidus* (Bull.), one of the original typical species of *Inonotus* Karst. The species here included in the genus *Inonotus* are brown, sessile, usually anoderm, with fibrous context and brown-tinted spores. There is considerable variation in spore coloration, the spores of some species being very deeply colored, while others are so pale as to appear almost hyaline, especially when not fully matured.

The largest species is *I. hirsutus*, sometimes over 30 cm. in diameter, while the smallest, *I. pusillus*, is rarely over two or three millimeters across. As regards the distribution of our species, two, *I. hirsutus* and *I. radiatus*, occur in Europe and in temperate North America; three others, *I. perplexus*, *I. dryophilus* and *I. amplectens*, appear to be confined to temperate regions of North America; while the remaining six are known only from certain localities in tropical America.

Synopsis of the North American species

1. Spores deep brown in color. 2.
Spores faintly tinted with brown. 5.

2. Surface of pileus hirsute, tubes luteous, margin obtuse; plants of large size and two centimeters or more in thickness. 1. *I. hirsutus.*
Surface of pileus conspicuously tomentose, margin acute; plants of medium size and one centimeter or less in thickness. 2. *I. perplexus.*
Surface of pileus glabrous or finely tomentose. 3.

3. Pileus 8 cm. or more in width, rigid, ferruginous throughout, margin rather obtuse. 3. *I. dryophilus.*
Pileus 5 cm. or less in width. 4.

4. Surface of pileus very rimose, tubes 2 cm. long. 4. *I. texanus.*
Surface of pileus rugulose and zonate, but not rimose, tubes 1 cm. long. 5. *I. jamaicensis.*

5. Pores scarcely visible to the unaided eye. 6.
Pores conspicuous. 7.

6. Pileus thick, azonate, margin obtuse, hymenium dull. 6. *I. corrosus.*
Pileus thin, zonate, margin very sharp, hymenium glistening. 7. *I. Wilsonii.*

7. Plants minute, only a few millimeters across, erumpent from lenticels of dead twigs. 8. *I. pusillus.*
Plants of medium size. 8.

8. Surface soft, anoderm, sporophores growing on living shrubs, often encircling the smaller branches. 9.
Surface hard, becoming encrusted, sporophores found on decaying wood. 9. *I. radiatus.*

9. Hymenium very concave, umbrinous, margin sharp and depressed. 10 *I. amplectens.*
Hymenium plane or nearly so, becoming almost black, margin rather blunt and not depressed. 11. *I. fruticum.*

1. **Inonotus hirsutus** (Scop.)

Boletus hirsutus Scop. Fl. Carn. ed. 2. 2: 468. 1772.
Boletus spongiosus Lightf. Fl. Scot. 1033. 1777.
Boletus hispidus Bull. Herb. Fr. *pl. 210.* 1784. *pl. 493.* 1791.

Boletus flavus Poll. Fl. Ver. **3**: 607. 1824.
Polyporus hispidus Fr. Syst. Myc. **1**: 362. 1821.
Polyporus endocrocinus Berk. Lond. Jour. Bot. **6**: 320. 1847.
Inonotus hispidus Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 39. 1879.
Inodermus hispidus Quél. Ench. 172. 1886.

As one would naturally suppose, such a large and attractive plant as this did not long remain unnoticed by the early mycologists. Micheli refers to it as the "hairy and obscure agaric with golden hymenium." Batarra figures it and calls it *Agaricus favaginosus uvidus*. Scopoli describes it as a *Boletus* with reddish hispid surface and white or reddish hymenium occurring on the trunks and branches of trees; and he assigns to it the specific name *hirsutus*. Bulliard not only described it well under his name *Boletus hispidus*, the name by which it is best known, but he also made two excellent plate figures of it showing its stages and varieties. Under one name or another it has received attention from nearly all writers who have treated this group.

To the stranger in Europe there are few more attractive species among the fungi. It grows in considerable abundance on the sycamore, ash, oak, beech, walnut, etc., often infesting a large part of the trunk and emerging in brilliantly colored sporophores from wounds made in pruning or other openings into the heartwood. These sporophores sometimes measure a foot and a half in diameter and are clothed above with a dense coat of long reddish hairs which become black with age. The hymenium is at first white but soon becomes yellow, yielding a yellow dye when treated with water.

In Sweden, this species is rare and occurs only on ash. It is also rare in the northern United States, but is somewhat more common farther south; although it is by no means so abundant here as in Europe. Its principal host in America is the oak. A year or two ago I collected seven large sporophores on a decayed spot in a living oak trunk at Fort Lee, New Jersey. This was in September and the fruit-bodies were already much decayed. Plants collected by Lea on hickory in Ohio in the latter part of August, 1844, were so advanced as to seem new to Berkeley, who named them *Polyporus endocrocinus*, remarking that the species was allied to *P. Schweinitzii*, but was distinguished by its saffron-colored substance and strigose-squamose pileus. The two specimens collected are still at Kew and are practically identical in form and appearance with my own collections made in September. The species has also been found by Commons in Delaware, Ellis in New Jersey, Memminger in North Carolina and Dr. Martin in Florida. European exsiccati are too numerous to mention here.

2. **Inonotus perplexus** (Peck)

Polyporus perplexus Peck, Rept. N. Y. State Mus. Nat. Hist. **49**: 19. 1896.

This species was described from plants collected by Peck on beech trunks in Oneida County, New York. It is hairy-tomentose to setose-hispid, resembling *I. cuticularis* and *I. hispidus*. Its spores are ferruginous and broadly elliptical, being smaller than those of *I. hispidus*. The same plant was distributed by Shear in his New York Fungi, *no. 110*, under the name of *Polyporus radiatus*. His specimens were found at Alcove, New York, on a dead beech trunk. Plants were recently determined for me by Prof. Peck, although he thinks the types were destroyed while the herbarium was housed in the state capitol.

The present species is well named *P. perplexus*, since it has troubled more than one mycologist and collector during the last quarter of a century, some calling it *P. cuticularis* because of its hairy surface and others passing it for *P. radiatus* on account of its general appearance and evident close relationship with that species. During the past summer I had the opportunity of studying a large number of the fresh and growing sporophores on the trunk of a living sycamore maple in Bedford City, Virginia; and found the velvety, bright ferruginous surface and the sharp, sterile margin very characteristic. It seems to range much farther south than *I. radiatus* and is also more commonly collected, although neither can be said to be abundant.

Specimens are at hand from Pennsylvania, *Stevenson;* Delaware, *Commons;* Maine, *Hodson;* Georgia, *Underwood;* Virginia, *Murrill 1005;* Alabama, *Earle;* Louisiana, *Langlois;* Mississippi, *Tracy*. The hosts given are oak, spruce (?), and maple. It occurs on trunks and logs of either dead or decaying trees.

3. **Inonotus dryophilus** (Berk.)

Polyporus dryophilus Berk. Lond. Jour. Bot. 6: 321. 1847.

The types of this species were sent from Ohio by Lea, who collected them on living trunks of red oak. The fruit-body is large and rigid, anoderm, ferruginous throughout, whitened externally by a fine canescence, with thin, angular, brown pores. The species resembles *Polyporus dryadeus*, but is smaller and more rigid and has larger and differently colored pores. In some respects it is allied to *Hapalopilus gilvus*, but the spores are deep ferruginous instead of hyaline and the pileus is much thicker, with a more obtuse margin. Excellent specimens are to be seen in the Ellis collection, which were found by Morgan in Ohio in 1885. He reports this species as occurring at the base of living oak trees and on oak logs.

4. **Inonotus texanus** sp. nov.

Pileus ungulate, attached by the vertex, 3 × 5 × 4 cm.; surface fulvous to fuliginous, concentrically and radially rimose, especially in age, the separated areas imbricated; margin very obtuse, concolorous: context corky, concentrically banded, fulvous to umbrinous, very thin, only one-tenth the length of the tubes in thickness; tubes 3 cm. long, 2–3 to a mm., tawny chestnut, polygonal, edges thin, entire; spores ovoid, smooth, very dark brown, 1–2-guttulate, 8 × 10 μ.

The above description is based upon a single rather old sporophore collected by Underwood on a mesquite (?) tree near Austin, Texas, November 24, 1891. Although young stages are not represented, still the characters as shown are very distinct.

5. **Inonotus jamaicensis** sp. nov.

Pileus dimidiate to triquetrous, convex, sessile, attached by a broad base, simple or imbricate, 2 × 3 × 1–1.5 cm.; surface encrusted, minutely rugose, cinereous behind, marked toward the margin with dark-brown or black zones; margin regular, often obtuse: context fibrous, fulvous, only a few millimeters thick; tubes 1 cm. long, 4 to a mm., larger by confluence, fulvous, polygonal to irregular, edges thin, entire; spores ovoid, smooth, deep ferruginous, 1–2-guttulate, very copious, 5 × 7 μ.

The type plants of this species were collected by Underwood on the Mabess river, Jamaica, at an altitude of 3,000 ft., April 23, 1903. None of the young stages was found. Judging from the fruit-bodies, the host must have been the small dead or dying branches of some broad-leaved tree.

6. **Inonotus corrosus** sp. nov.

Pileus conchate, clasping, simple or imbricate, 3 × 5 × 1–4 cm.; surface ferruginous to fulvous, furrowed and much corroded in age; margin entire, obtuse, tomentose, honey-yellow: context thick, spongy, fibrous, ferruginous, perforated by insects soon after maturity; tubes very short, only 1 mm. long each season, 8 to a mm., fulvous, subcylindrical, edges entire, obtuse to acute; spores lenticular, smooth, pale ferruginous, 4 μ in diameter, 1 μ thick, hyphae deep ferruginous.

The type plants of this species were collected by Earle, *no. 203*, near Hope Gardens, Jamaica, October 27, 1902. They grew upon a dead vine clinging to a tree. Two or three years growth were represented in the much weathered and wormeaten central parts of the sporophores, while the latest growths stood out in marked contrast. The flattened appearance of the spores may be due to desiccation, but this character is fairly constant. A single sporophore of this species was also collected in the island of New Providence by Britton, *no. 246*, Aug. 24, 1904, growing on a small dead twig.

What appear to be specimens of this same plant are placed at Kew under *Polyporus chrysites* Berk., a species described from the region of the Rio Negro river in Brazil as thin and leathery, while the various plants bearing that name at Kew are mostly thick and soft or even hard and perennial. Specimens collected in Cuba by Wright should probably belong to *I. corrosus* instead of to *P. chrysites*.

7. **Inonotus Wilsonii** sp. nov.

Pileus dimidiate, applanate, sessile, 2–3 × 4–6 × 0.5 cm.; surface anoderm, velvety-tomentose, fulvous, marked with a few shallow concentric furrows; margin thin, entire, concolorous, sulcate, deflexed in drying: context soft, punky, homogeneous, ferruginous-fulvous, 1–3 mm. thick, separated from the tubes by a very thin black layer; hymenium ferruginous, glistening, tubes 1–2 mm. long, 6–9 to a mm., isabelline within, mouths polygonal, regular, edges thin, entire; spores lenticular, smooth, pale ferruginous, 3–4 μ in diameter, 1–1.5 μ thick.

This species was collected by Percy Wilson, *no. 438*, on decaying logs in Honduras, Feb. 16, 1903. It resembles some plants called *P. chrysites* at Kew, but is quite distinct from that species. The shape of the spores as given above may be due to extreme desiccation.

8. **Inonotus pusillus** sp. nov.

Pileus sessile, convex, flabelliform, tapering to a narrow base, erumpent from lenticels, 2 × 2 × 0.5–1 mm.; surface ferruginous to fulvous, silky-striate, subzonate, shining, margin pallid, acute, often depressed: context thin, fibrous, ferruginous; tubes umbrinous, comparatively large, 2–4 to a mm., polygonal, becoming irregular, much exceeding in length the thickness of the context; mouths at first whitish-pulverulent, dissepiments thin, entire: spores small, ovoid, 3.5 × 5 μ, pale ferruginous, copious, hyphae concolorous.

This species is based upon plants collected by Dr. Edward Palmer, *no. 1520*, at Manzanillo, Mexico, in 1892. The tiny brown sporophores were found in large numbers emerging from the lenticels of small dead branches of *Jacquinia*. It was apparently recognized as a new species by Ellis and Galloway and distributed by them jointly under the genus-name *Trametes*, and later listed by Patouillard (Tax. Hymen. 101. 1900) as a species of *Xanthochrous*. The tentative name first proposed for the species is here made use of, but according to present usage I am, unfortunately, not permitted to cite the authors, since no description accompanied the name.

This is one of the very smallest plants met with in the *Polyporaceae*. Two other tiny plants are of interest in this connection, *Porodiscus pendulus*, which is also erumpent from lenticels, but has hyaline spores; and *Coltriciella dependens*, which is more like the present species in general appearance and structure, but is stipitate instead of sessile, having the stipe attached to the vertex of the pileus like the handle of a tiny bell.

9. INONOTUS RADIATUS (Sowerby) Karst.

Boletus radiatus Sowerby, Eng. Fung. *pl. 196.* 1799.

Polyporus radiatus Fr. Syst. Myc. **1**: 369. 1821.

Polyporus glomeratus Peck, Rept. N. Y. State Mus. Nat. Hist. **24**: 78. 1873.

Inoderma radiatum Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 39. 1879.

Inonotus radiatus Karst. Rev. Myc. 3: 19. 1881.

This species was first described from specimens collected on a decaying stump in Sussex, England. In the description, Sowerby refers to its habit of emerging from the substratum in a small woolly mass and then growing in a radiating manner with this mass as a center. He describes the pileus as zoned, with yellow margin, and the texture as woody. Berkeley mentions hazel stems as its favorite host in England. In Sweden it is abundant on hazel and birch, while in Germany and Austria it is found mostly on alder, which last is its most common host in America.

The form found on a prostrate sugar maple trunk and described as *P. glomeratus* by Peck, in 1873, hardly differs sufficiently from the typical form to constitute a distinct species. With the two forms before me, I can find no specific distinguishing character either with the unaided eye or with the microscope. This similarity was long since noticed and published by Cooke. The relations of *Polyporus scrobiculatus*, and various forms included in *Inonotus radiatus* by Karsten, to the typical form of this species do not come within the scope of the present paper.

Specimens are at hand from England, *Plowright;* Berlin, *Magnus, Hennings;* Tyrol, *Bresadola;* Sweden, *Murrill;* Canada, *Macoun;* Connecticut, *Underwood;* New York, *Peck, Earle.*

10. **Inonotus amplectens** sp. nov.

Pileus hemispherical, clasping, concave beneath, 1–3 cm. in diameter, 1–2 cm. thick; surface soft, velvety, dark yellowish orange, margin at first obtuse, entire, straw-colored, becoming thin, undulate or toothed, deflexed and concolorous: context soft, spongy-fibrous, ferruginous; hymenium at first honey-yellow, becoming umbrinous, tubes 2–4 mm. long, 2–4 to a mm., larger by confluence, umbrinous within, mouths at first closed by a yellowish membrane, subcircular, regular, entire, becoming large, irregular, coarsely toothed and concentrically split into irpiciform plates; spores ellipsoidal, smooth, hyaline, 1–2-guttulate, 4 × 6 μ.

Type specimens of this plant were collected by R. M. Harper, *1990a*, on the Ocmulgee river near Lumber City, Georgia, Sept. 11, 1903. The fruit-bodies were found encircling living twigs of *Asimina parviflora* (?). The upper surface of the plant resembles *Inonotus fruticum* (B. & C.), but the hymenium is very distinct.

11. **Inonotus fruticum** (B. & C.)

Polyporus fruticum B. & C. Jour. Linn. Soc. Bot. **10**: 310. 1868.

This species was named from its habit of growing upon shrubs. In shape it varies from thin and dimidiate to nearly spherical, according to its position on the branch and the size of the branch. If on a small twig it frequently encircles it. The pileus is very soft and spongy and the pores become almost black. Orange and oleander are mentioned as hosts. Several well-preserved specimens are among Wright's Cuban collections at Kew.

SPECIES INQUIRENDAE

Polyporus aureonitens Pat. & Peck, Rept. N. Y. State Mus. Nat. Hist. **42**: 25. 1889.

This species is based on material collected in New York by Peck and described by Patouillard. It occurs on birch, alder and maple. There are several specimens of it in the herbarium here collected in Massachusetts, Connecticut and New York. In his original publication, Peck says it is related to *P. radiatus*, but is distinguished by its paler color, often lineate-zoned pileus and paler spores. In a recent letter to me, Dr. Peck distinguishes *P. glomeratus* from *P. aureonitens* as follows: "*P. glomeratus* differs from *P. aureonitens* in its darker colors, more uneven surface of the pileus, entire absence of concentric lines or narrow zones on the surface of the pileus, which is more irregular and wavy on the margin, and never shining. Its spores in mass are of a brighter, richer, yellow color. The two are readily distinguished at sight by any one who has seen them growing."

By referring to Sowerby's description of the young stages of *P. radiatus*, it will be seen that the zonate pileus and yellow margin are present in that species. Also excellent European specimens from Bresadola and others, called by them *young P. radiatus*, seem to differ in no particular from New York specimens of *P. aureonitens*. It can hardly be imagined that two such eminent mycologists as Peck and Patouillard could have confused American and European species in this way, but they may not have had at hand good material of the young stages for comparison. In view of the above facts, I have thought it best to defer the settle-ment of the question at least until I can study our American form in the field.

Sesia Adans. Fam. **2**: 10. 1763

Serda Adans. Fam. **2**: 11. 1763.
Gloeophyllum Karst. Hattsv. **2**: 79. 1882.
Lenzitina Karst. Finlands Basidsv. 337. 1889.

The genus *Sesia* was founded upon Vaillant's figures of *S. hirsuta* (Schaeff.) drawn from specimens collected on the timbers of a boat at St. Cloud, Paris. The genus *Serda* is based upon a resupinate form of the same species collected at the same time and place and figured in the same work. In establishing the genus *Gloeophyllum*, Karsten overlooked Adanson's genera already founded and later even overlooks or purposely changes his own generic name to *Lenzitina*. All four names above mentioned are strictly synonymous, being founded on the same type species. Karsten listed three other European species, *L. abietina* (Bull.), *L. cinnamomea* (Fr.) and *L. septentrionalis* Karst., as congeners of the type.

The species of this genus have white spores, brown substance and normally daedaleoid or lamelloid tubes. Abnormal poroid forms quite frequently occur. All the species are found on decaying wood, and, as is often the case, some grow only on the wood of conifers, while others are confined to deciduous wood. *S. hirsuta* is abundant in the northern hemisphere on coniferous wood of all kinds, *S. Berkeleyi* is rare on coniferous wood in tropical America; *S. pallidofulva* is abundant in North America on wood of deciduous trees, while its place is taken in tropical America by *S. striata*. The species are all of medium size, easily distinguished by striking characters.

Synopsis of the North American species

1. Context ferruginous to chestnut.	2.
Context avellaneous to umber.	3.
2. Surface hirsute.	1. *S. hirsuta*.
Surface finely tomentose or glabrous.	2. *S. Berkeleyi*.
3. Furrows broad, a millimeter or more in width, pileus very thin, multizonate.	3. *S. striata*.
Furrows narrow, only a half of a millimeter in width, pileus rather thick, usually devoid of zones.	4. *S. pallidofulva*.

1. SESIA HIRSUTA (Schaeff.) Murrill

Agaricus hirsutus Schaeff. Fung. Hist. *pl. 76.* 1762.
Agaricus saepiarius Wulf. in Jacq. Collect. **1**: 347. 1786.
Agaricus boletiformis Sowerby, Eng. Fung. *pl. 418.* 1814.
Daedalea saepiaria Fr. Obs. Myc. **1**: 105. 1815.
Lenzites saepiaria Fr. Epicr. 407. 1838.
Lenzites rhabarbarina B. & C. Ann. Mag. Nat. Hist. II. **12**: 428. 1858.—Grevillea, **1**: 35. 1872.
Sesia hirsuta Murrill, Jour. Myc. **9**: 88. 1903.

This species is very abundant in the north temperate zone on logs, stumps and various other decaying wood of pine, fir, spruce, hemlock, juniper and other coniferous trees. It varies considerably in its wide range. In the higher regions of Colorado and adjoining states, for example, it is large and coarse and almost shaggy; while in the southeastern states, on the other hand, it is thinner and less densely hirsute than the typical European form, with more delicate, easily lacerated gills and a somewhat differently colored surface. The latter form was described from South Carolina by Berkeley and Curtis as *Lenzites rhabarbarina*, but I cannot distinguish it specifically from many of the typical specimens of *S. hirsuta.* It has been quite frequently collected in the South by Earle, Langlois, Britton, Schrenk and others. Another form, called *var. porosa* by Peck, is very distinct and would constitute a good species if it could be proven to be constant. In one instance Peck found a number of specimens on a single pine trunk that were all alike poroid. Further observation might establish a definite form found sometimes alone and sometimes growing with the species under consideration.

From the large list of specimens examined in connection with this study the following are listed to show the range of the species: Canada, *Macoun*, *Dearness*; New York, *Peck*, *Jelliffe*, *Underwood*; Maine, *Miss White*; New Jersey, *Ellis*; Connecticut, *Miss White*; Ohio, *Morgan*; Colorado, *Underwood & Selby*; Montana, *Rydberg & E. Bessey*, *Anderson*; Tennessee, *Murrill 689*; Virginia, *Murrill 121*, *152*; Alabama, *Earle*, *Schrenk*; Florida, *Britton*; Louisiana, *Langlois*; Sweden, *Murrill*; Switzerland, *Murrill*; Tyrol, *Bresadola*, *Murrill.*

2. **Sesia Berkeleyi** (Sacc.)

Daedalea rhabarbarina Berk. & Cooke, Grevillea, **6**: 130. 1877; not *D. rhabarbarina* Mont.

Daedalea Berkeleyi Sacc. Syll. Fung. **6**: 381. 1888.

This species was described from specimens collected on pine stumps near Gainesville, Florida. The fruit-body is larger than in any other American species and the surface is only slightly tomentose, becoming glabrous with age. The margin is much lighter than the surface, being tawny-orange in color and contrasting vividly with the dark umber of the older growth. It is also more porous than most species of *Sesia*, the tubes rarely becoming more than sinuous, though it is sometimes lamellate in parts of the tropics where the fruit-body grows quickly. The only specimens at hand are those collected by C. G. Lloyd in Florida and by Smith in Nicaragua and Mexico.

3. **Sesia striata** (Sw.)

Agaricus striatus Sw. Prodr. 148. 1788.—Fl. Ind. Occ. **3**: 1920. 1806.

Daedalea striata Fr. Syst. Myc. **1**: 334. 1821.

Lenzites striata Fr. Epicr. 406. 1838.

Lenzites protracta Fr. Nov. Symb. 45. 1851.

This species was the first of two plants listed by Swartz in his *Prodromus* under the genus *Agaricus*, the second being *Schizophyllum alneum*, also common in Jamaica. The brief description, "*A. acaulis, convexus ferrugineus pubescens, margine integro, lamellis alternis interruptis cinereis*," is, as usual, much amplified in his later work.

Specimens from Mexico, still to be seen in the Fries herbarium at Upsala, were described by Fries as *L. protracta*, a name which has been generally assigned in Europe to a very different plant. Fries also called some of the Mexican collections of this species *L. umbrina*.

Sesia striata is quite abundant on decaying wood in various parts of tropical America, as the following partial list of specimens will show: Colombia, *Baker;* Nicaragua, *Smith;* Honduras, *Wilson 200, 276;* Mexico, *Smith;* Cuba, *Underwood & Earle 503, 740, 750, 1526, 1562, Shafer;* Jamaica, *Underwood 740, Earle 82,* *96, 118, 145, 161, 180;* Porto Rico, *Earle 53;* New Providence, *Mrs. Britton;* Florida, *C. G. Lloyd.*

4. **Sesia pallidofulva** (Berk.)

Daedalea pallidofulva Berk. Hook. Lond. Jour. **6**: 322. 1847.
Lenzites vialis Peck, Rept. N. Y. State Mus. Nat. Hist. **26**: 67. 1874.

This species was described from material collected by Lea in Ohio in 1842. The type plants were taken from a dead log in a log fence in March. According to Berkeley, it stands exactly intermediate between *Daedalea* and *Lenzites.* Specimens sent to Fries by Berkeley are still to be seen in the herbarium at Upsala and they correspond in all points with the plant known as *Lenzites vialis* Peck, described from specimens found on railroad ties in New York by Peck in 1874.

The present species is a very common one in the United States, occurring abundantly on railroad ties and other dead timber of oak, willow, ash and other deciduous trees and more rarely on coniferous wood; though the broad general distinction between this species and *S. hirsuta* in regard to host usually holds good, the former being common on coniferous wood and the latter on deciduous wood. In appearance, there is considerable difference in the two species, *S. pallidofulva* being less brightly colored, and less distinctly zoned, with the furrows closer, shorter and more porous. The margin also is white when fresh and turns dark when bruised. There is a close resemblance between this species and *L. trabea* (Pers.) Fr., which occurs on deciduous wood in Europe.

The following specimens are at hand: Canada, *Dearness;* New Jersey, *Ellis;* New York, *Barnhart, Murrill, Peck;* Ohio, *Morgan, C. G. Lloyd;* Indiana, *Underwood;* Louisiana, *Langlois;* Kentucky, *Miss Price;* Tennessee, *Murrill 494, 495, 542, 579;* Iowa, *Macbride, Holway;* Pennsylvania, *Rau, Banker.*

SPECIES INQUIRENDAE

Lenzites mexicana Mont. Ann. Sci. Nat. II. Bot. **20**: 360. 1843. Collected on dead wood in the province of Oaxaca, Mexico, by Andrieux. Apparently a stipitate and otherwise abnormal form of *S. striata*, but Montagne is decidedly opposed to this opinion and specimens are not at hand to settle the question. Compare his remarks on this point:

"Si l'on ne considère que l'hyménium de ce *Lenzites*, il est évident qu'on le distinguera mal du *L. striata;* mais si l'on observe la disposition du duvet dressé et comme conglutiné qui forme les zones concentriques, la profondeur des sillons qui séparent ces zones, et l'aspect rugueux et peluché qui en résulte, caractères que je ne rencontre dans aucun des nombreux individus du *L. striata*, on se convaincra promptement que, quoique voisines, ces deux espèces ne sauraient être confondues."

Daedalea Burserae Pat. Jour. de Bot. **3**: 341. 1889. Described from plants found on rotten wood of *Bursera gummifera* in Martinique by Duss. It is said by the author to be easily distinguished from all its congeners by the yellow powder which covers its pores in the young stages. I have not seen the type plants.

Daedalea jamaicensis P. Henn. Hedw. **37**: 281. 1898. Collected on dead wood at Port Antonio, Jamaica, and thus described:

"Pileo suberoso-spongioso, dimidiato, sessile, interdum imbricato, zonato sulcatoque rugoso, rufo-brunneo vel atro-violaceo nigricante, zonis obscurioribus, margine pallidiori, acuto; intus cinnamomeo; hymenio poroso-labyrinthiformi vel sinuoso-lamelloso, subochraceo vel subcinerescente."

This species is very near to *Sesia Berkeleyi*. Further study of the type plants, however, is necessary in order to decide whether or not the two species are synonymous.

ISCHNODERMA KARST. Medd. Soc. Faun. et Fl. Fenn. **5**: 38. 1879

This genus was founded upon *Isch. resinosum* (Schrad.) and four other European species, the one here mentioned being the nomenclatorial type. Karsten describes the genus as follows:

"Receptaculum pileatum, sessile, primitus subcarnoso-succosum dein induratum, crusta tenuiore tectum. Hymenium heterogeneum. Pileus azonus. Pori integri, demum subsecedentes."

Ischnoderma fuliginosum (Scop.)

Boletus fuliginosus Scop. Fl. Carn. ed. 2. **2**: 470. 1772.
Boletus rubiginosus Schrad. Spic. Fl. Ger. 168. 1794.

Boletus resinosus Schrad. Spic. Fl. Ger. 171. 1794.
Trametes benzoina Fr. Epicr. 489. 1838.—Icon. *pl. 483. f. 2.*

This large and striking species was originally described from Carniola by Scopoli. It is quite abundant in temperate regions of Europe and North America on fallen trunks of basswood, beech, maple, fir, spruce, etc. On account of its habit of growing beneath logs, the fruit-bodies often persist in a good state of preservation until the following spring. Logs are frequently found entirely covered on the under side with these extensive hymenophores. Whether the form found on coniferous wood is the same as that occurring on hard wood is an old question. There seems to be usually some difference in size and color, but after examining a large assortment of specimens, it seems impossible to distinguish the forms specifically either in this country or in Europe. More specimens from coniferous trees in this country would doubtless throw light on the question.

The following specimens have been examined in the Garden herbarium: Ell. N. A. Fung. *406*; Shear, N. Y. Fung. *112*; Kellerman, Ohio Fung. *105*; Canada, *Dearness, Macoun*; New York, *Earle, Atkinson, Miss Overacker, Murrill*; Delaware, *Commons*; Pennsylvania, *Sumstine*; West Virginia, *Nuttall*; Virginia, *Ricker*; Ohio, *James, Lloyd, Kelsey, Kellerman*; Michigan, *Merrow*; Wisconsin, *Baker*; Alabama, *Earle*; Florida, *Calkins*; Tyrol, *Bresadola & Murrill.*

Laetiporus gen. nov.

Hymenophore annual, epixylous, fleshy, anoderm, caespitose-multiplex; context cheesy to fragile, light-colored, tubes thin-walled, fragile, bright yellow, mouths irregularly polygonal; spores smooth, hyaline.

This genus is based on *Agaricus speciosus* Batarr. Fung. Hist. 68. *pl. 34. f. B.* 1755, commonly known as *Polyporus sulphureus* Fr. It may be at once distinguished from species of *Grifola* by its yellow color and arboreal habit. The generic name chosen refers to the brilliantly colored hymenium.

Laetiporus speciosus (Batarr.)

Agaricus speciosus Batarr. Fung. Hist. 68. *pl. 34. f. B.* 1755.
Boletus sulphureus Bull. Herb. France, *pl. 429.* 1788.
Boletus citrinus Planer, Ind. Plant. Erf. 26. 1788.

Polyporus sulphureus Fr. Syst. **1**: 357. 1821.
Polypilus sulphureus Karst. Rev. Myc. **3**: 17. 1881.
Polypilus speciosus Murrill, Jour. Myc. **9**: 93. 1903.

This species is widely and abundantly distributed both in Europe and America and is exceedingly well known on account of its size, conspicuous habitat, and bright attractive coloring. The mycelium spreads widely through the trunks of deciduous, and even evergreen, trees, causing serious damage, while the sporophores appear annually in caespitose-multiplex masses at knot-holes on the affected parts. The various names under which the plant has been known all refer to the bright color of these sporophores, which are usually reddish-yellow above and sulfur-yellow below, fading to almost white with age. A few of the numerous collections in which this plant figures are noted here: Sweden, *Murrill;* Maine, *Miss White;* Connecticut, *Miss White;* Delaware, *Commons;* New York, *Peck & Earle;* Pennsylvania, *Everhart & Haines;* New Jersey, *Ellis, Murrill;* Alabama, *Earle;* Louisiana, *Langlois;* Mexico, *Smith.*

Trichaptum gen. nov.

Hymenophore annual, epixylous, sessile, dimidiate; context brown, firm and leathery below, very loosely fibrous and darker above; tubes short, thin-walled, mouths polygonal, becoming labyrinthiform; spores smooth, hyaline.

The type of this genus is *Polyporus trichomallus* Berk. & Mont. (Ann. Sci. Nat. III. **11**: 238. 1849), described from Guiana. It resembles the old-world genus *Funalia* erected by Patouillard in 1900 with *P. mons-veneris* Jungh., *P. leoninus* Kl. and *P. funalis* Fr. as typical species and *P. trichomallus* Berk. & Mont. in a subsection; but it may be easily distinguished from *Funalia* by its darker context and daedaleoid hymenium. While splitting often occurs, rendering the hymenium irpiciform, the splitting is not so radical as in *Funalia.* The name chosen refers to the loosely woven context.

Trichaptum trichomallum (Berk. & Mont.)

Polyporus trichomallus Berk. & Mont. Ann. Sci. Nat. III. **11**: 238. 1849.
Funalia trichomalla Pat. Tax. Hymen. 95. 1900.

The type plants of this species were collected in the eastern part of Guiana by Poiteau and fully described by Montagne. It has since been frequently collected in many parts of South America and ranges northward to Central America and the West Indies. Plants seen in some herbaria labelled *P. heteromallus* are only large zonate forms of this species. A decidedly sinuous hymenium is present in specimens recently collected in Cuba and Jamaica. Collections are at hand from Bolivia, *Williams;* Colombia, *Baker;* Nicaragua, *Smith;* San Domingo, *Massee;* Jamaica, *Underwood 2833;* Cuba, *Underwood & Earle 1131.*

Pogonomyces gen. nov.

Hymenophore annual, epixylous, dimidiate-sessile to flabelliform, thickly covered with rigid hairs; context dark-brown, punky, tubes short, thick-walled, mouths small, circular; spores smooth, hyaline.

This genus is founded upon *Boletus hydnoides* Sw. (Prodr. 149. 1788), described from Jamaica. It may at once be distinguished from *Trichaptum* by its small, cylindrical, very thick-walled tubes. The name selected refers to its thick covering of bristly hairs.

Pogonomyces hydnoides (Sw.)

Boletus hydnoides Sw. Prodr. 149. 1788.—Fl. Ind. Occid. **3**: 1924. 1806.

Boletus hydnatinus Bosc, Gesell. Natur. Freunde Mag. **5**: 84. *pl. 4. f. 3.* 1811.

Polyporus pellitus Mey. Fl. Esseq. 304. 1818.

Boletus crinitus Spreng. Vet. Acad. Handl. 51. 1820.

Boletus fibrosus Hook. in Kunth, Syn. Pl. **1**: 10. 1822.

Polyporus Feathermanni Rav. Grevillea, **6**: 130. 1877.

This very abundant tropical species was first described in 1788 from Jamaica. In enlarging his original brief description for the Flora of the West Indies, Swartz also enlarged his description of the type locality to read: "On trees in the mountains of Jamaica." In 1811, Bosc describes and roughly figures the same plant, remarking that "one might use it as the type of a new genus." Meyer later described it from South America under the name of *Polyporus pellitus*, and Sprengel from Porto Rico, as *Boletus crinitus*. Its most recent name was assigned by Ravenel to specimens collected by Featherman at Gainesville, Florida.

The great abundance and striking appearance of this species account for the attention which it has received, but should tend rather to lessen than to increase the list of synonyms. Every expedition to the southern states or the West Indies discovers quantities of it. The following list of specimens will indicate its range: Florida, *Martin, Calkins, Small & Carter 1319, 1331, 1332, 1351; Britton 127, 128, 343, 366, 448, 477;* Louisiana, *Langlois 1280;* Cuba, *Underwood & Earle 374, 1524, 1532, 1538;* Porto Rico, *Earle 30, 52, Underwood, Wilson 114;* Haiti, *Nash 24;* Jamaica, *Earle 200, 425b, 189, 619;* Yucatan, *Millspaugh;* Colombia, *Baker;* Nicaragua, *Smith, Shimek;* Mexico, *Smith.*

SPECIES INQUIRENDAE

Trametes ocellata B. & C. Jour. Linn. Soc. Bot. **10**: 319. 1868. Investigation had indicated that this species also was synonymous with *P. hydnoides*, but the recent discovery of a large-pored specimen by Small and Nash on Totten's Key, Florida, reopens the question and further comparison and probably more material will be necessary in order to settle it satisfactorily. The evanescent membrane mentioned by the authors in connection with this species appears to be present also in *P. hydnoides* and cannot serve as a distinguishing character.

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CONTRIBUTIONS FROM THE NEW YORK BOTANICAL
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ON PISONIA OBTUSATA AND ITS ALLIES

By N. L. BRITTON

NEW YORK
1904

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, 31: 611-615. November, 1904]

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, 31: 611–615. November, 1904.]

On Pisonia obtusata and its allies

N. L. BRITTON

Pisonia obtusata was described by Jacquin in Hort. Schoenbr. **3**: 36 (1798), and figured at *pl. 314* of that work; a detailed description is given of the plant which came from the island of New Providence, Bahamas, "in insula providentiae." Eight years later, in 1806, Swartz in Fl. Ind. Occ. **3**: 1960, described another *Pisonia obtusata*, which came from the island of Saint Bartholomew, one of the Windward Islands, south of St. Thomas. Grisebach in Fl. Br. W. I., 71, credits the species to Swartz and not to Jacquin, making no mention of the type locality in the Bahamas, and this blunder is continued by Heimerl in Engler's Bot. Jahrb. **21**: 625, in his monograph of West Indian *Nyctaginaceae*, although he cites Jacquin's original description and figure, placing it, however, after his citation of Swartz. This all goes to show that attention to type localities is desirable.

In looking over the collections of Bahamian plants made by Professor Coker, during the exploration conducted by the Geographical Society of Baltimore in the summer of 1903, and those made by me in the summer of 1904, I have had occasion to identify the *Pisonia obtusata* of Jacquin, which is well illustrated by several specimens.

Contingent upon his error in the proper identification of the species, Heimerl has described (*loc. cit.*) the Bahama plant as *Pisonia calophylla*, which thus becomes a synonym of *P. obtusata* Jacq.

A further part of the history of the misidentification of this species is to be found in the reference of the plant of southern Florida to *Pisonia obtusata* Sw., by Chapman, South. Fl. 374; by Sargent, Silva, **6**: 111. *pl. 297*, and by Small, Fl. SE. U. S. 411; this has nothing to do with either the *Pisonia obtusata* of Jacquin or with that of Swartz; Heimerl has included it in his *Pisonia discolor longifolia* (*loc. cit.* 627), making, I believe, a further error in supposing it to be only a form of *P. discolor* Spreng., the type locality of which is Jamaica.

The *Pisonia obtusata* of Swartz has been referred, together with *P. coccinea* Sw., which came from Haiti, to *P. inermis* Jacq., originally from Cartagena on the mainland of South America, but without the present opportunity to examine type-specimens I am unable to verify this reference; Heimerl places *P. coccinea* Sw., in the related genus *Neea*. *Pisonia Pacurero* H.B.K. is referred by Grisebach and by the Index Kewensis to *P. inermis*, and plants from the Windward Islands, Porto Rico and Jamaica, as well as numerous South American specimens, certainly appear to be conspecific with the one figured on *plate 24* of the Botany of the Herald; if Herr Heimerl had stopped to compare the plate of Jacquin illustrating *P. obtusata* with this illustration, I think he could not have failed to have noticed that they represent two entirely different species, although he cites them both under *P. obtusata* Sw.

I have a further criticism to make of current generic references of these trees to the genus *Pisonia* L., the type species of which is *P. aculeata* L., a woody vine with recurved prickles and clavate gland-bearing fruit; the trees under consideration being wholly unarmed and with red drupe-like fruits, the smooth fleshy or juicy exocarp completely enclosing the hard ribbed anthocarp; that they can be congeneric with *P. aculeata* it is quite impossible to believe after seeing them growing in proximity with it in the Bahamian coastal thickets, and from an examination of the literature bearing on *Pisonia* I conclude that the generic name *Torrubia* Vell. Fl. Flum. 139 (1825), is the first one available for them, having as its type *T. opposita* Vell. *loc. cit.*, from maritime woods at Santa Cruz, Brazil. The Floridian and West Indian species known to me are as follows:

1. **Torrubia obtusata** (Jacq.)

Pisonia obtusata Jacq. Hort. Schoenbr. **3**: 36. *pl. 314*. 1825.
Pisonia calophylla Heimerl, Bot. Jahrb. **21**: 625. 1896.

Leaves oval or elliptic, thick, rounded at the apex, 6–9 cm. long, about twice as long as wide, often revolute-margined, the upper ones subcordate, the lower sometimes rounded or a little narrowed at the base; petioles stout, 3–5 mm. long; fruit bright red, shining, juicy, the anthocarp 5–8 mm. long.

Low coppices and scrub lands, mostly near the sea, island of

New Providence, Bahamas, *Cooper 18* and *23*; *Curtiss 126*; *Coker 5* and *252*; *Brace 163*, *183* and *189*; *Britton & Brace 176* and *484*.

2. **Torrubia rufescens** (Griseb.).

Pisonia calophylla rufescens Heimerl, Bot. Jahrb. **21**: 626. 1896.

Pisonia rufescens Griseb.; Heimerl, *loc. cit.*, as synonym.

Leaves thick, flat, obovate, finely and densely tomentulose beneath, rounded or truncate at the apex, cuneately narrowed at the base, the stout petioles 1–1.5 cm. long.

Cuba, *Wright 464*.

3. **Torrubia Cokeri** Britton, sp. nov.

Glabrous, the twigs gray. Leaves firm, obovate, 8 cm. long or less, 3–4 cm. wide, rounded at the apex, narrowed or somewhat cuneate at the base; petioles stout, about 1 cm. long; flowers sessile, the perianth and corymb-branches minutely tomentulose; staminate perianth about 3 mm. long, bluntly 5-toothed, about one-half as long as the stamens.

Tarpum Bay, Eleuthera, Bahamas, *Coker 401* (type); Cuba, *Linden 1988*.

This is included by Heimerl in his *P. calophylla*, in so far as Linden's specimens are concerned, but it is certainly distinct; Wright's Cuban numbers *2041* and *2042*, cited by Heimerl under *P. calophylla*, I have not seen.

4. **Torrubia suborbiculata** (Hemsl.)

Pisonia suborbiculata Hemsl.; Duss, Ann. Inst. Colon. Marseilles, **3**: 62. 1897.

A low glabrous shrub, 2.5 m. high or less, with round or broadly obovate glaucous leaves less than 4 cm. long, their petioles extremely short; fruit pulpy, cylindric, red and glaucous when ripe.

Known only from Martinique; *Duss 1467* and *4391*.

5. **Torrubia discolor** (Spreng.)

Pisonia discolor Spreng. Syst. **2**: 168. 1825.

Leaves oblong-elliptic, thin, 8 cm. long or less, 2–4 cm. wide, obtuse at the apex, narrowed at the base, slender-petioled; anthocarp about 6 mm. long, about one-half as thick as long; fruit oblong, red, the pulp rather thin.

The type is from Jamaica; the species is also known from Haiti (according to Heimerl), and from Cuba, *Wright 2040*; *Combs 446*; *Britton & Wilson 72*.

6. **Torrubia longifolia** (Heimerl).

Pisonia discolor longifolia Heimerl., Bot. Jahrb. **21**: 627. 1896.

Pisonia obtusata Chapm. South. Fl. 374. 1860. Not Jacq.

Leaves thin, the blades obovate to spatulate, 5 cm. long or less, or on young shoots longer, 2 to 4 times as long as wide, rounded or often emarginate at the apex, the very slender petioles 8–13 mm. long; fruiting corymbs dense or loose; fruit very juicy, shining, bright red to magenta red, obovoid-cylindric to globose-obovoid, often depressed at the top, the anthocarp 5–6 mm. long.

Type from the Bahamas, where it is very abundant in coastal coppices.

BAHAMAS: New Providence, *Brace 129* and *387*; *Coker 15* and *41*; *Britton & Brace 164*, *166*, *178* and *292*; Andros, *Northrop 517*; St. George's Cay, *Coker 316*; Watling Island, *Coker 472*.

FLORIDA: Key West, *Blodgett*, "large tree flowering in the summer;" same island, *Blodgett*, "shrub 10–15 feet;" Indian River, *Curtiss 2338*; Palm Beach, *Curtiss 5379*; Miami, *Garber*, *Britton 404*; Annette Key, *Simpson 342*, shoots showing the obovate nearly veinless leaves; Bull Key, *Small & Carter 657* and *660*.

CUBA: seashore near Matanzas, *Rugel 411*.

7. **Torrubia Bracei** Britton, sp. nov.

A slender tree, 5 m. high or less, the bark gray. Leaves thin, green on both sides; petioles very slender, 6–8 mm. long; blades narrowly obovate, 5 cm. long or less, rounded at the apex, cuneate-narrowed at the base; fruiting pedicels about 0.5 mm. long; fruit very juicy, oblong-obovoid, twice as long as thick, claret-red, truncate at the top; anthocarp 7–8 mm. long, 2 mm. thick.

Coastal coppice, Ft. Montague, New Providence, Bahamas, *Britton & Brace 168*, August 23, 1904.

This grows in company with the next preceding species and with *P. obtusata*, and is certainly different from either of them.

8. **Torrubia inermis** (Jacq.).

Pisonia inermis Jacq. Select. Am. 275. 1763.

Pisonia obtusata Sw. Fl. Ind. Occ. **3**: 1960. 1806. Not Jacq.

This type is from Cartagena, South America. The species, as I understand it, is widely distributed in northern South America and in the West Indies south of the Bahamas. It is said by Heimerl to grow in Florida, but our collections from that State do not contain it.

9. **Torrubia floridana** (Britton).

Pisonia floridana Britton; Small, Fl. SE. U. S. 411. 1903.

Known only from Rock Key, Florida, and readily distinguished from the other species by its dense pubescence.

Key to the above-mentioned species

- Petioles stout.
  - Petioles 3–15 mm. long; blades 6–9 cm. long.
    - Petioles 3–5 mm. long; leaves subcordate. 1. *T. obtusata.*
    - Petioles 1–1.5 cm. long; leaves cuneate or narrowed at the base.
      - Leaves densely brown-tomentulose beneath. 2. *T. rufescens.*
      - Leaves glabrous on both sides. 3. *T. Cokeri.*
  - Petioles only 1 or 2 mm. long; blades 4 cm. long or less. 4. *T. suborbiculata.*
- Petioles slender.
  - Leaves glabrous.
    - Leaves rounded at the apex or emarginate.
      - Leaves oval or oblong. 5. *T. discolor.*
      - Leaves obovate or oblanceolate.
        - Fruit globose-obovoid, little longer than thick; anthocarp 5–6 mm. long. 6. *T. longifolia.*
        - Fruit oblong-obovoid, twice as long as thick; anthocarp 7–8 mm. long. 7. *T. Bracei.*
    - Leaves pointed, sometimes only bluntly acute. 8. *T. inermis.*
  - Leaves densely pubescent, small. 9. *T. floridana.*

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STUDIES ON THE ROCKY MOUNTAIN FLORA—XIII

By PER AXEL RYDBERG

NEW YORK
1904

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, 31: 631-655. December, 1904]

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, 31 : 631-655. December, 1904.]

Studies on the Rocky Mountain flora — XIII

PER AXEL RYDBERG

Dodecatheon multiflorum sp. nov.

Plant glabrous, perennial with a very short caudex and cluster of fibrous roots; leaves about 2 dm. long, sinuate-denticulate, obtusish, narrowly oblanceolate, tapering below into a short petiole; scape stout 3–4 dm. high; bracts linear-lanceolate, 1–2 cm. long; flowers 10–20; the longer pedicels often over 1 dm. long; calyx-tube 5–6 mm. long, more or less turbinate at the base; lobes lanceolate, about 5 mm. long; corolla bluish violet, paler in the throat but without any markings; lobes oblong, obtuse; filament-tube obsolete; anthers narrowly linear-lanceolate, acute, 7–8 mm. long; connective narrow, lance-subulate, with a longitudinal groove, but not rugose; capsule about 12 mm. long, cylindric-ovoid, septicidal.

In habit this species resembles *D. radicatum* and *D. pauciflorum*, but differs in the stamens, which are almost without a filament-tube. In river valleys at an altitude of 2400–2700 m.

COLORADO: Sangre de Cristo Creek, 1900, *Rydberg & Vreeland 5781*.

WYOMING: Elk Mountains, 1899, *Little & Stanton*.

Dodecatheon radicatum sinuatum var. nov.

Leaves more elongated than in the type, oblong, rarely elliptic, sinuate, thin.

COLORADO: Foothills, Larimer County, 1890, *Crandall* (type); Buena Vista, 1892, *C. S. Sheldon;* Fort Collins, 1896, *Baker*.

Gentianella Clementis sp. nov.

Annual, usually more or less branched, 2–4 dm. high; stem sharply angled; internodes usually longer than the leaves; these 3–6 cm. long, the basal ones spatulate, the cauline ones lanceolate, acuminate, truncate or even subcordate at the base, sessile; peduncles 1–4 from the axils of the leaves, more or less elongated 1–6 cm. long; sepals linear, acute, usually very unequal in length, the longer often ⅔ as long as the blue or greenish-yellow corolla; corolla 15–18 mm. long; lobes ovate-lanceolate, acute.

This belongs to the *Amarella* group of *Gentiana* and is perhaps most nearly related to *G. plebeja*, which, however, has shorter ovate or ovate-lanceolate, acute or obtuse stem-leaves, lower stem and shorter and more nearly equal calyx-lobes. *G. Clementis* grows in the mountains from South Dakota and Montana to Colorado and Arizona. As the type I regard the following:

COLORADO: Minnehaha, 1901, *Clements 253*.

Frasera speciosa stenosepala var. nov.

Usually with very numerous flowers; sepals narrowly linear, some of them usually equaling or exceeding the petals; petals large, about 15 mm. long or more; floral leaves very long and narrow.

In the mountains and foothills of Colorado and Wyoming. As the type may be regarded:

COLORADO: Foothills, Larimer County, 1895, *Cowen*.

Frasera speciosa angustifolia var. nov.

Low, 3–4 dm. high; basal leaves very short; stem-leaves narrowly linear-lanceolate; floral leaves, except the lower, shorter than the branches of the inflorescence; petals rather small, about 12 mm. long.

On dry hillsides from Montana to Colorado. As the type may be regarded:

MONTANA: Lima, 1895, *Shear 3369*.

Gilia scariosa sp. nov.

Perennial with a tap-root; stems one to several, simple, strict, 3–6 dm. high, glandular-puberulent throughout; leaves numerous, alternate, pinnatifid with linear-filiform spinulose-tipped divisions, more or less white-villous when young, glandular-puberulent; inflorescence a narrow, strict, interrupted thyrsus; branches very short, few-flowered; calyx-tube about 6 mm. long, puberulent, scarious except the green angles; teeth short, broadly rounded-ovate, abruptly contracted into a subulate acumination; corolla pink, 3–4 cm. long; tube narrow, very gradually broadening upwards; lobes ovate-lanceolate, acute, about 8 mm. long; stamens very unequally inserted; capsule obovoid, about 1 cm. long.

This is closely related to *G. aggregata*, but differs in the scarious calyx with short, abruptly cuspidate-acuminate lobes. The lobes of the corolla are also acute rather than acuminate. The species is common in Colorado, in open valleys. It was first collected by James in Long's expedition; but James' specimen in the Torrey herbarium is a mere scrap. I have therefore selected as the type a better specimen, viz.:

COLORADO: Veta Pass, 1896, *C. L. Shear 3590.*

Gilia spergulifolia sp. nov.

Gilia congesta crebrifolia Wats, King's Exp. 5: 268, in part. 1871. Not *G. crebrifolia* Nutt.

Low perennial, more or less woody at the base, more or less cespitose; flowering branches 5–10 cm. high, more or less pubescent with white, crisp hairs or puberulent; leaves linear-filiform, entire or the upper rarely with 1–2 similar lobes, tipped with a pungent point; flowers in capitate clusters, which are usually on naked peduncles; bracts similar to the leaves but smaller; calyx villous with short subulate pungent teeth; corolla 4–5 mm. long, white; lobes oblong, obtuse, a little over 1 mm. long.

This has been mistaken for *G. crebrifolia* Nutt., but that species has much shorter fleshy leaves and very short copiously leafy flowering stems. It is nearer related to *G. iberidifolia*, from which it differs in the entire leaves and solitary heads ending the branches.

WYOMING: Headwaters of Tongue River, 1898, *Tweedy 576* (type).

COLORADO: Arboles, 1899, *Baker 534.*

UTAH: Bear River Valley, 1869, *Watson 917.*

Gilia roseata sp. nov.

Perennial with a woody base, cespitose; flowering branches about 1 dm. high, purple-tinged, more or less villous or crisp-hairy; leaves pinnatifid with linear-filiform pungent-pointed lobes, about 2 cm. long; flowers capitate at the ends of the leafy branches; bracts similar, shorter, rose-tinged and more villous; calyx also very pubescent and rose-tinged; lobes subulate and spinulose-pointed; corolla about 8 mm. long; its lobes 4–5 mm. long, elliptic, obtuse.

This species is nearly related to *G. iberidifolia*, but differs in the larger flowers (in *G. iberidifolia* the corolla-lobes are rarely over 2 mm. long), the rose-colored bracts, purplish stem and more solitary heads.

COLORADO: Grand Junction, 1892, *Alice Eastwood.*

Gilia polyantha sp. nov.

Perennial with a short woody base; stems several, 3–4 dm. high, striate and simple up to the inflorescence, glandular-puberulent; leaves 3–4 cm. long, pinnatifid, glabrous or with a few white hairs; lobes linear-filiform, pungent-pointed; flowers numerous in a narrow thyrsus; calyx campanulate, about 5 mm. long, more or less scarious at the sinuses; lobes broadly ovate-triangular, abrubtly cuspidate-pungent; corolla white, about 1 cm. long, funnelform-salvershaped; lobes about 5 mm. long, lance-oblong, obtusish; filaments about equaling the corolla-lobes, somewhat incurved.

This has been mistaken for *G. multiflora* Nutt., but is more closely related to *G. Macombii* Torr., differing mainly in the shorter corolla and shorter pubescence.

COLORADO: Pagosa Springs, 1899, *Baker 538*.

Gilia Tweedyi sp. nov.

Annual, branched, 2–4 dm. high; stem and branches glandular-puberulent, especially the upper part; leaves 2–3 cm. long, pinnatifid, with lanceolate cuspidate lobes; flowers paniculate; pedicels 1–8 mm. long; calyx about 3 mm. long, scarious between the green ribs; lobes lanceolate; corolla funnelform, about 4 mm. long, bluish; capsule ovoid, about 4 mm. long.

This species is related to *G. inconspicua* and *G. minutiflora*. From the former it differs in the smaller corolla, of which not only the corollà-tube but also the throat is included in the calyx; from the latter it differs in the pinnatifid leaves. *G. Tweedyi* grows in river bottoms and on sandy soil, at an altitude of 1000–2200 m.

WYOMING: Encampment, Carbon County, 1901, *Tweedy 4422* (type); between Sheridan and Buffalo, 1900, *Tweedy 3481;* Fort Steele, 1901, *Tweedy 4421;* also, 1898, *Aven Nelson 4802*.

Gilia Crandallii sp. nov.

Perennial with a woody tap-root; stem 3–5 dm. high, sparingly puberulent, glandular above, rather stout, much branched; basal leaves 3–10 cm. long, spatulate or oblanceolate, serrate or pinnately lobed, with lanceolate teeth or lobes; lower stem-leaves often similar; the upper narrower and usually entire; calyx glandular, about 5 mm. long; teeth lanceolate, scarious-margined; corolla salvershaped, about 15 mm. long, rose color; tube about 1 mm.

wide below, about 2 mm. at the throat; lobes oblong-spatulate, acutish; capsule about 5 mm. long, acute.

This has been mistaken for *G. Haydeni*, but that species is a much more slender plant with shorter calyx, scarcely scarious-margined lobes, minute subulate stem-leaves and shorter (3.5 mm. long) obtuse capsule. It is more closely related to *G. subnuda*, but differs in the branched stems and the finer and sparser pubescence. It grows in dry soil, especially on "sage-plains," at an altitude of 1900–2100 m.

COLORADO: Durango, 1898, *Crandall 2053* (type) and *2040;* also 1896, *Tweedy 448;* Mancos, 1898, *Baker, Earle & Tracy 404;* also 1901, *Vreeland 885.*

Polemonium robustum sp. nov.

Perennial with a woody caudex; stem 4–10 dm. high, more or less short-villous and above glandular; leaves 6–10 cm. long, glandular-pubescent; leaflets 11–17, lanceolate or lance-oblong, acute, 1.5–2.5 cm. long; the upper confluent and decurrent on the rachis; inflorescence much branched and corymbiform, but the main axis usually overtopping the branches; calyx glandular-villous, 7–8 mm. long; lobes lanceolate; corolla rose or purplish, 12–15 mm. high; lobes rounded and obtuse.

This species is a close relative to *P. foliosissimum*, but differs in the large flowers and the more conical or obovoid inflorescence. It grows in the mountains of Colorado, especially along streams, at an altitude of 2400–3000 m.

COLORADO: Bob Creek, La Plata Mountains, 1898, *Baker, Earle & Tracy 274* (type); Keblar Pass, 1901, *Baker 796;* Clear Creek Cañon, 1885, *Patterson 104;* Sangre de Cristo Creek, 1900, *Rydberg & Vreeland 5718;* Veta Pass, 1900, *Rydberg & Vreeland 5717.*

Polemonium Grayanum sp. nov.

Perennial with a cespitose rootstock; stems about 1 dm. high, glandular-villous; leaves 3–5 cm. long, glandular-villous; leaflets at least of the basal leaves more or less verticillate, obovate or spatulate, 2–6 mm. long, obtuse; calyx about 18 mm. long, villous with white hairs; lobes linear-lanceolate; corolla about 2 cm. long, campanulate-funnelform with a wide tube; lobes rounded.

This species is nearest related to *P. viscosum* Nutt., but is characterized by the long white hairs on the calyx. It grows on the higher peaks of Colorado among rocks, at an altitude of 2700–4000 m.

COLORADO: Gray's Peak, 1895, *Rydberg* (type); also 1886, *Letterman 323*; Graymount, *Letterman 322*; Central City, 1869, *Leville.*

Phacelia sericea ciliosa var. nov.

Usually taller than the typical *P. sericea*, often 5 dm. high, not silvery, green; pubescence very sparse and short, except some long silky hairs on the pedicels and lower portion of the stem.

This variety has been mistaken for *P. Lyallii* and *P. idahoensis.* It has been confused with the first on account of the similar pubescence, but *P. Lyallii* is a much smaller plant and with less deeply dissected leaves. It resembles *P. idahoensis* very closely in general habit, but in that species the stamens are only slightly exserted and the corolla smaller. The variety has the same range as the species, but grows usually at a lower altitude. As the type may be taken:

COLORADO: North of Merker, 1902, *Osterhout 2619.*

Lappula Besseyi sp. nov.

Biennial; stem 5–10 dm. high, hirsute, branched above; lower leaves petioled, 6–15 cm. long; blades spatulate or oblanceolate, obtuse, hispidulous and hirsute on the veins; upper leaves sessile, lanceolate; inflorescence branched; bracts small; pedicels in fruit 4–5 mm. long, more or less reflexed; corolla dark blue, scarcely over 1.5 mm. wide; fruit about 3 mm. wide; marginal spines distinct and in one row; back flat, spineless, but minutely hispidulous.

In general habit this species resembles most *L. floribunda*, but is distinguished by the very small flowers and fruit. It grows in cañons at an altitude of about 2400 m.

COLORADO: Cheyenne Cañon, 1895, *E. A. Bessey* (type); also in 1896.

Lappula angustata sp. nov.

Biennial or short-lived perennial; stem strict, hirsute, 6–8 dm. high; lower leaves petioled, 9–15 cm. long, strigose or hirsute on the petioles; blades narrow, linear-oblanceolate, mostly acute; stem-leaves linear-lanceolate, sessile; inflorescence with strongly ascending branches; pedicels reflexed in fruit, about 5 mm. long; corolla blue, about 4 mm. wide; fruit 4–5 mm. wide; marginal prickles united $\frac{1}{3}$–$\frac{1}{2}$ their length into a distinct wing, the alternate ones usually much smaller; back slightly keeled, without prickles, minutely hispidulous or glabrous.

In habit this species also resembles *L. floribunda*, but is distinguished by the narrow leaves and the united marginal prickles of the fruit. These characters would place it near *L. scaberrima*, which, however, has a different pubescence.

South Dakota: Oreville, 1902, *Rydberg 891* (type).

Colorado: La Veta, 1896, *Shear 3640*.

Oreocarya argentea sp. nov.

Cespitose perennial; stems 3–4 dm. high, hispid; basal leaves spatulate or oblanceolate, obtuse, 5–6 cm. long, densely white- or yellowish-pubescent, partly with stiff bristle-like hairs, partly with fine hairs, but all strictly appressed; stem-leaves oblanceolate, with the bristles more spreading; inflorescence narrow and virgate; calyx in fruit 8–10 mm. long, hispid; its lobes linear-lanceolate; corolla white, less than 5 mm. long; its tube included and limb 5–6 mm. wide; nutlets about 3.5 mm. long, papillose and with more or less distinct cross-ridges.

This species is perhaps nearest related to *O. sericea*, which, however, is a much smaller plant and has mammillate-papillose nutlets without cross-ridges. It grows on dry hills in Colorado.

Colorado: Rifle, Garfield County, 1900, *Osterhout 2122*.

Oreocarya eulophus sp. nov.

More or less cespitose perennial; stem about 2 dm. high, hispid with yellowish hairs; basal leaves numerous, spatulate, 4–5 cm. long, finely cinereous and appressed hispid; stem-leaves oblanceolate, with the hispid hairs more spreading and often yellowish; inflorescence a narrow and almost spikelike thyrsus; calyx in fruit about 7 mm. long, yellowish hispid; its lobes lanceolate; corolla white, 10–12 mm. long; tube exserted from the calyx; limb about 5 mm. wide; nutlets 4–5 mm. long, with irregular honeycomb-like crests.

This species is a near relative of *O. fulvocanescens* and *O. cristata*, but easily distinguished in fruit by its nutlets. It grows on gravelly hills at an altitude of 1800–2300 m.

Colorado: Dolores, 1892, *Crandall* (type); McCoy's, 1903, *Osterhout 2750*.

Utah: Price, 1900, *Stokes*.

Mertensia picta sp. nov.

Perennial, perfectly glabrous, except the hispidulous-ciliate margins of the leaves and calyx-lobes; stem 3–5 dm. high, pale and somewhat bluish below, more or less angled; lower leaves petioled; blades oval or elliptic-ovate, 5–9 cm. long, obtuse or acutish, rounded or somewhat truncate at the base, finely pustulate but not hairy on the surfaces, thin; upper leaves lanceolate or ovate-lanceolate and subsessile; inflorescence leafy and with short branches; pedicels and calyx more or less pustulate; calyx-lobes linear-oblong, obtuse, in fruit nearly 2 mm. long, the back with a thickened pale spot; corolla blue; its tube 6–7 mm. long and 2–3 mm. wide; throat and limb together 5–6 mm. long, the latter about 5 mm. wide; filaments dilated, about 2 mm. long and wider than the anthers; nutlets ovate in outline, strongly and irregularly reticulate-crested on the back.

This is closely related to *M. ciliata* but distinguished by the pale-spotted and thickened calyx-lobes.

COLORADO: Estes Park, Larimer County, 1903, *Osterhout 2823* (type); Mount Baldy, 1901, *Clements 288.*

Mertensia polyphylla platensis var. nov.

Like the species, but the calyx-lobes linear, fully 3 mm. long; basal leaves large; blades about 1 dm. long, cordate at the base and cuspidate at the apex.

Along streams at an altitude of 3000 m.

COLORADO: Bob Creek, La Plata Mountains, 1898, *Baker, Earle & Tracy 180* (in part).

Mertensia alba sp. nov.

Perennial; stem pale, 6–8 dm. high, more or less branched; lower leaves petioled, upper sessile; blades lanceolate or elliptic-lanceolate, acute or acuminate at both ends, glabrous beneath, hispidulous-strigose above and on the margins; pedicels and calyx strigose; lobes linear-lanceolate, acute, about half as long as the tube of the white corolla; corolla-tube about 8 mm. long, and 4 mm. wide; throat and limb together of about the same length; the latter 8–10 mm. wide; nutlets irregularly crested-tuberculated, and finely pubescent.

This is a species of the *M. paniculata* group and nearest related to *M. pratensis*, but it lacks the dense white pubescence of the calyx characterizing that species and the corolla in all specimens seen is white.

COLORADO: La Plata River, 1898, *Baker, Earle & Tracy 825.*

Mertensia viridula sp. nov.

Perennial with a cespitose rootstock; stems slender, 2–3 dm. high, glabrous; leaves glabrous beneath, hispid-strigose above; the lower petioled, the upper sessile; blades of the basal ones spatulate, obtuse; those of the stem-leaves acute, elliptic, or the upper lanceolate; pedicels strigose; calyx glabrous, except the base and the margins of the lobes; these broadly lanceolate, about 2.5 mm. long; corolla blue; tube about 4 mm. long; throat and limb of about the same length; filaments broader than the anthers; nutlets muricate and somewhat irregularly ridged.

This species resembles *M. viridis* A. Nels. closely in habit, but the dilated conspicuous filaments associate it with *M. linearifolia* and *M. ovata*, from which it is distinguished by the broader calyx-lobes. It grows in the mountains at an altitude of 2700–3800 m.

COLORADO: North Cheyenne Cañon, 1894, *E. A. Bessey* (type); West Spanish Peak, 1900, *Rydberg & Vreeland 5683*.

Mertensia Parryi sp. nov.

Perennial with a cespitose rootstock; stems about 2 dm. high, glabrous; leaves glabrous beneath, hispidulous-strigose above, only the basal ones petioled and spatulate; stem-leaves sessile, lanceolate or oblanceolate, about 5 cm. long; inflorescence small and short; pedicels strigose; calyx glabrous except the very base and the ciliate margins of the lobes; these narrowly linear-lanceolate, about 3 mm. long; tube of the blue corolla about 5 mm. long and about equaling the length of the throat and limb together; limb about 8 mm. wide; filaments evident but short, broader than the anthers.

This species is nearest related to *M. ovata* Rydb., but differs in the narrower leaves and the comparatively longer corolla-limb. In *M. ovata* the tube is longer than the throat and limb together. *M. Parryi* grows in the higher mountains.

COLORADO: Alpine ridges lying east of Middle Park, *Parry 286* (type); Estes Park, 1903, *Osterhout 2848*; Cameron Pass, 1896, *Baker*; Alpine Tunnel, 1897, *Shear 3853*.

Mertensia perplexa sp. nov.

Perennial with branched rootstock; stem about 3 dm. high, glabrous; basal leaves spatulate, 4–10 cm. long, petioled; stem-leaves sessile; the lower oblanceolate; the upper ovate, glabrous beneath, minutely hispidulous-strigose above; pedicels minutely hispid-strigose; the hairs with pustulate bases; calyx glabrous except the ciliate margins of the lobes; these oblong-lanceolate, acute or obtuse; corolla blue, about 12 mm. long; tube equaling the throat and limb; the latter 7–8 mm. wide; tube densely villous at the base within; anthers subsessile, inserted a little below the throat.

This species is evidently nearest related to *M. alpina*, notwithstanding the much larger size and erect habit. The corolla is almost twice as long as in that species.

COLORADO: Mountains south of Ward, Boulder County, 1901, *Osterhout 2439*.

Mertensia canescens sp. nov.

Low and cespitose perennial with woody caudex; stems about 1 dm. high, strigose; leaves linear or linear-oblanceolate, grayish strigose on both sides; pedicels and calyx strigose; calyx-lobes linear-lanceolate, acute, about 2 mm. long, on the margin ciliate with longer hairs; corolla blue, about 8 mm. long; tube 1.5 mm. wide and about as long as the throat and the limb, the latter about 3 mm. wide; anthers subsessile at the margin of the corolla-tube.

Closely related to *M. alpina*, it is easily distinguished by the canescent and narrow leaves. It grows on the mountains at an altitude of 3360–3600 m.

COLORADO: Berthaud Pass, 1903, *Tweedy 5664* (type); mountains northwest of Como, 1895, *Cowen 1808*.

Stachys teucriformis sp. nov.

Perennial, 4–6 dm. high; stem round-angled, glandular-villous; lower leaves short-petioled, the upper sessile; blades oblong or oblong-ovate to ovate, cordate or truncate at the base, 5–10 cm. long, crenate, pubescent on both sides; calyx glandular, villous, its lobes linear-lanceolate, long-aristate, about equaling the tube; corolla 12–15 mm. long, light rose, with reddish-purple veins and blotches; upper lip narrow and nearly straight; lower lip large, 3-lobed; lateral lobes triangular; middle lobe rounded-reniform.

The species is closely related to *S. scopulorum*, but differs from it in the larger corolla, the longer calyx-lobes and the usually broader leaves. The type sheet contains two specimens: one of *S. teucriformis* and one of *Teucrium occidentale*, and the two are so alike in foliage that it is hard to distinguish them except by the flowers and bracts.

COLORADO: New Windsor, 1894, *Osterhout* (type); McCoy, 1898, *Shear & Bessey 5302*; Colorado Springs, 1896, *Shear 5189.*

Monardella dentata sp. nov.

Cespitose perennial, somewhat ligneous at the base; stems slender, light brown, about 3 dm. high; leaves short-petioled; blades ovate, 1.5–2 cm. long, serrate-dentate, finely pubescent and strongly punctate, obtuse, strongly veined beneath; heads terminal, solitary, about 1.5 cm. in diameter; bracts lanceolate, obtuse, nearly 1 cm. long, finely canescent, strongly veined, rather thick, of fully as firm structure as the upper leaves; calyx about 8 mm. long, grayish pubescent; lobes lanceolate; corolla about 12 mm. long; its lobes linear, 4 mm. long.

This has been mistaken for *M. odoratissima*, but is easily distinguished by the distinctly toothed leaves and the narrow firm bracts.

COLORADO: Gray's Peak, 1872, *Torrey.*

Solanum interius sp. nov.

Annual, more or less branched; stem 3–6 dm. high, usually with narrow denticulate margins or wings, finely pubescent with short white appressed crisp hairs; leaves with short winged petioles, sparingly pubescent above, usually densely grayish-strigose beneath; blades deltoid or rhombic, 3–7 cm. long, acuminate, usually sinuately lobed or dentate with acute or acuminate lobes or teeth; peduncles 2–4 cm. long, strigose; inflorescence corymbiform, rarely umbelliform; pedicels in fruit about 1 cm. long, recurved but scarcely reflexed; calyx-lobes ovate, 2 mm. long, abruptly acute, in fruit appressed or spreading; corolla yellowish-white; lobes ovate, acute, 3–4 mm. long; filaments very short, less than 0.5 mm. long, glabrous; anthers oblong, about 2 mm. long, yellow, obtuse, opening by terminal pores; berry greenish black, nearly 1 cm. in diameter.

This has gone under the name of *S. nigrum* throughout the interior region where it is a native plant; but the true *S. nigrum* of Europe has almost glabrous leaves with rounded lobes if lobed at all, very obtuse sepals, subumbellate inflorescence and usually reflexed pedicels in fruit. *S. interius* is in reality more closely related to *S. Douglasii*, which, however, differs in the much larger and bluish corolla. It is with some doubt I propose this species as new, as several North American species were described by

Dunal in De Candolle's Prodromus; but our plant does not agree with the description of any of these, except perhaps that of *S. pterocaulon;* a specimen of the latter cited by Dunal is in the herbarium of Columbia University, and this shows that it is more closely related to *S. nodiflorum* than to *S. nigrum.*

S. interius grows in river valleys and on sandy soil among bushes at an altitude of 600–1800 m.

NEBRASKA: On Middle Loup River, near Mullen, 1893, *Rydberg 1385* (type).

KANSAS: Reno County, 1897, *Hitchcock 362-a.*

COLORADO: Near Boulder, 1902, *Tweedy 5236;* Timnath, 1899, *Osterhout;* along Platte River, Denver, 1878, *M. E. Jones 605;* Cañon City, 1896, *Shear 3777;* Bent's Fort, 1846, *Lt. Abert.*

ARIZONA: Chiricehun Mountains, 1894, *Toumey.*

NEW MEXICO: Mesilla, Dona Ana County, 1898, *Wooton 50.*

Pentstemon strictiformis sp. nov.

Perennial with a woody caudex; stems 3–5 dm. high, glabrous and strict, simple; basal leaves petioled, 5–10 cm. long; blades oblanceolate, obtuse, glabrous and slightly glaucous; stem-leaves sessile, lanceolate, acuminate, 4–8 cm. long; inflorescence more or less secund; calyx-lobes lanceolate, acuminate, 8–10 mm. long, more or less scarious and dentate on the margin; corolla violet-purple, funnelform, somewhat gibbous, about 2.5 cm. long and limb nearly 2 cm. wide; anthers long-villous with white hairs; sterile stamen villous with yellow hairs.

This is closely related to *P. strictus*, but differs mainly in the long-acuminate sepals. It grows up to an altitude of 2800 m.

COLORADO: Mancos, 1898, *Baker, Earle & Tracy 76* (type); Gray-Back Mining Camp, 1900, *Rydberg & Vreeland 5630;* Arboles, 1899, *Baker 602.*

Pentstemon oreophilus sp. nov.

Perennial branched at the base, perfectly glabrous throughout, 2–4 dm. high; basal leaves oblanceolate, obtuse, short-petioled; stem-leaves lanceolate and sessile, 5–10 cm. long, acute or acuminate; inflorescence dense and usually more or less one-sided, calyx 8–10 mm. long; lobes lanceolate, long-acuminate with toothed scarious auriculate sides; corolla funnelform, more or less gibbous, bluish purple, 12–15 mm. wide at the mouth; lower lip more or less bearded within; anthers hispidulous on the margin and more or less short-hairy on the back and sides; sterile stamen with yellow beard at the end.

This is closely related to *P. glaber* and *P. alpinus*, differing from the former in the lower habit and the shape of the calyx-lobes, which in *P. glaber* are orbicular or short ovate and with very scarious erose margins. *P. alpinus* Torr. (= *P. riparius* A Nels.), is more or less puberulent throughout. *P. oreophilus* grows at an altitude of 1800–3600 m.

COLORADO: Eldora to Baltimore, 1903, *Tweedy 5711* (type) and *5710*; Halfway House, 1896, *Shear 4781*; Manitou, 1896, *Clements 171*; Larimer County, 1893, *Crandall*; Quartz Ridge, Pike's Peak, *Clements 113*: South Cheyenne Cañon, 1895, *E. A. Bessey*; mountains near Empire, 1892, *Patterson 256*.

Pentstemon cyathophorus sp. nov.

Perennial and more or less cespitose at the base, glabrous throughout or the basal leaves minutely puberulent; stem very strict, 3–4 dm. high; basal leaves spatulate, petioled, 3–6 cm. long; lower stem-leaves also spatulate; the others ovate or orbicular, often abrubtly acuminate or mucronate; bracts round, ovate or orbicular, abruptly short-acuminate, the upper usually scarious-margined and erose, reniform and the pairs together resembling a cup; calyx 6–8 mm. long; lobes lanceolate, scarious-margined and more or less erose-dentate; corolla pink-purple, a little over 12–15 mm. long, more or less open funnelform from a narrow tube, little oblique and scarcely gibbous; anthers glabrous; sterile stamen spatulate at the apex and with a yellow beard.

This is closely related to the northern *P. acuminatus* and has been mistaken for it, but differs in the scarious-margined and toothed calyx-lobes and upper bracts. It grows in mountain meadows at an altitude of 2500–3000 m.

COLORADO: Pearl, 1901, *Tweedy 4307* (type); Grizzly Creek, 1896, *Baker*; also 1894, *Crandall 1438*; North Park, 1896, *Osterhout 59*; also 1891, *Crandall 1439*.

Castilleja brunnescens sp. nov.

Perennial with a short cespitose caudex; stems 3–5 dm. high, more or less pubescent and purplish; leaves narrowly linear-lanceolate, more or less distinctly 3-nerved, 4–5 cm. long, finely pubescent; bracts ovate to oblong-lanceolate, obtuse or rounded at the apex, entire or with a short tooth on each side, tinged with pale brown; calyx about 2 cm. long, densely and finely pubescent, cleft about equally deep in front and on the back; each division with 2 lanceolate lobes, about 3 mm. long; corolla about 3 cm. long; upper lip about 1 cm. long; lower about 3 mm.

This species may be most closely related to *C. confusa* Greene, but is easily distinguished by the light brownish color of the obtuse bracts. On account of this light color the type-specimens were labeled *C. pallida*, which it resembles somewhat but has an altogether different corolla. It grows in the mountains at an altitude of 2700–3300 m.

COLORADO: Cameron Pass, 1896, *Baker* (type); Gray's Peak, 1871, *Porter;* Red Mountain, south of Ouray, 1901, *Underwood & Selby 293;* Pike's Peak, 1894, *E. A. Bessey.*

Castilleja obtusiloba sp. nov.

Perennial with a very short caudex; stem very sparingly hairy, 3–4 dm. high; lower leaves oblong-lanceolate, 3-nerved, minutely pubescent, 3–4 cm. long, entire; the upper broader, 3-cleft; lateral lobes lanceolate; the middle one oblong, obtuse; bracts similar, but broader, purple; middle lobe elliptic, rounded at the apex; calyx about 2.5 cm. long, almost equaling the corolla, equally deeply cleft in front and on the back; lobes short, oblong and rounded at the apex; corolla yellowish and purple-tinged; upper lip nearly 1 cm. long; lower nearly 3 mm.

This species is perhaps a near relative of *C. rhexifolia* and *C. confusa*, but easily distinguished by the peculiar bracts and short and very obtuse calyx-lobes. It grows at an altitude of about 2700 m.

COLORADO: Leroux Park, Delta County, 1892, *Cowen.*

Castilleja puberula sp. nov.

Perennial with a short cespitose caudex; stems less than 1 dm. high, finely puberulent; leaves 2–3 cm. long, pinnately divided into linear lobes or entire and linear, finely puberulent; bracts similar, but shorter and broader, tinged with yellowish, often more villous; calyx more or less villous, 1–1.5 cm. long, deeper cleft in front than on the back; lobes lanceolate, acute; corolla yellowish, 18–20 mm. long; upper lip 6–8 mm. long; lower lip 3–4 mm., very gibbous.

This species has been taken for *C. brachyantha* Rydb. (*C. brevi-*

flora A. Gray); but that species is a much taller plant and the galea is about three times as long as the lower lip. It grows at an altitude of 2500–3600 m.

COLORADO: 1872, *Parry* (type, in herb. Columbia University): Empire, 1903, *Tweedy 5742*; Berthoud Pass, 1903, *Tweedy 5741*.

Valeriana trachycarpa sp. nov.

Perennial with a thick fleshy root; stem glabrous or nearly so, 5–7 dm. high; basal leaves oblanceolate or spatulate, 7–18 cm. long, finely puberulent, especially on the margins and veins; entire or with a few linear lobes, thick; stem-leaves 1–2 pairs, pinnatifid with linear lobes; inflorescence large and branched; corolla of the staminate plant 2.5–3 mm. wide; that of the essentially pistillate plant about 1.5 mm. wide; fruit broadly ovate, not hairy, but strongly rugose.

This is closely related to *V. edulis* and *V. purpurascens*, but the former has pubescent ovary and fruit and narrower bracts, and the latter has narrower fruit, narrower leaves, more slender inflorescence and smaller staminate flowers, only 2 mm. wide; *V. trachycarpa* grows at an altitude of 2500–3000 m.

COLORADO: Red Mountain, 1901, *Underwood & Selby 352* (type); Alpine Tunnel, *441*; Marshall Pass, 1901, *Baker 481*; Rabbit Ears Pass, 1896, *Baker*.

NEW MEXICO: White Mountains, 1897, *Wooton 320*.

Valeriana ovata sp. nov.

Perennial with a rootstock; stem about 3 dm. high, glabrous; basal leaves entire, petioled, glabrous; petioles 2–6 cm. long; blades ovate, usually truncate or slightly cordate at the base, acute, entire or sinuate; stem-leaves 2–3 pairs; lateral lobes oblong to linear-lanceolate; the terminal one lanceolate or of the lower leaves elliptic; inflorescence small and corymbiform; corolla funnelform-salvershaped, about 8 mm. long; limb of the fertile flowers about 4 mm. wide; of the staminate ones about 6 mm. wide; fruit ovate, glabrous.

This species belongs to the *V. septentrionalis* group, but is characterized by its basal leaves. It grows on wooded hillsides at an altitude of 2400–2900 m.

COLORADO: Cameron's Cove, 1901, *Clements 241* (type).

NEW MEXICO: Cañon four miles east of Santa Fé, 1897, *Heller 3613*; Elizabeth Town, 1897, *Berg*.

Coleosanthus albicaulis sp. nov.

Brickellia Wrightii and *B. californica* A. Gray, Syn. Fl. 1^2: 106; both in part. 1884.

Shrubby at the base, 0.5–1 m. high; bark of the older wood brownish, striate and fissured, that of the younger branches straw-colored or grayish, hirsute-puberulent, more or less flaky; leaves short-petioled; blades broadly cordate, 2–5 cm. long, strongly veined, thick, scabrous-puberulent, crenate-dentate; inflorescence consisting of small axillary clusters scarcely exceeding the leaves, of 2–6 heads on short peduncles; heads 10–20-flowered; involucres turbinate; lower bracts short-ovate, the inner linear, all acutish or obtuse, greenish straw-color; corolla cream-color; pappus white.

This has been confused mostly with *C. Wrightii*, but the type of that species has more ovate leaf-blades, longer petioles, longer flower clusters, which exceed the leaves, and purple-tinged involucre, the bracts of which are very obtuse or rather rounded at the apex. It is rather nearer **Coleosanthus reniformis** (*Brickellia reniformis* A. Gray); from which it differs mainly in the longer, cordate, not reniform leaf-blades and larger and sharper teeth. It grows on the foothills and in cañons at an altitude of 1500–2500 m.

COLORADO: Manitou, 1900, *Clements* (type); Larimer County, 1891, *Cowen;* Lower Boulder Cañon, 1901, *Osterhout 2411;* Spring Cañon, 1897, *Crandall 2785;* Manitou, 1896, *Shear 4589;* Golden, 1895, *Shear 3261;* Mount Harvard, 1896, *Clements 63;* Golden, 1895, *Rydberg;* Boulder, 1885, *Letterman.*

UTAH: Salt Lake City, 1880, *M. E. Jones 1921;* Wahsatch Mountains, 1869, *Watson 495;* Provo, 1887, *Tracy & Evans 709.*

Grindelia serrulata sp. nov.

Biennial or perhaps short-lived perennial; stem glabrous, about 6 dm. high; leaves sessile, oblanceolate or oblong, acutish, very viscid, 3–5 cm. long, finely and densely serrate; inflorescence corymbiform; involucre very viscid, about 15 mm. broad; bracts subulate, very squarrose and reflexed; ligules 7–8 mm. long, 1–1.5 mm. wide; pappus-awns apparently smooth; barbules seen only under a compound microscope.

This is nearly related to *G. perennis* and *G. squarrosa.* From the former it differs in the closely and sharply toothed leaves, and from the latter in the oblanceolate instead of ovate or oval leaves. It grows on plains at an altitude of about 1500 m.

COLORADO: Fort Collins, 1891, *Cowen* (type); Denver, 1869, *B. H. Smith.*

Grindelia aphanactis sp. nov.

Apparently perennial; stem 3–4 dm. high, glabrous and striate; leaves very viscid, oblanceolate, acute, 4–7 cm. long, sharply dentate and sessile, or the lower more or less pinnatifid and petioled; inflorescence corymbiform; heads about 15 mm. broad; bracts very viscid, subulate; all very squarrose and the lower reflexed; rays none; awns of the pappus apparently smooth.

This species has been confused with *G. nuda* Wood, but that species has broad leaves and large heads and resembles in general habit more the radiate *G. squarrosa*. *G. aphanactis* grows in gravelly soil.

COLORADO: Durango, 1898, *Baker, Earle & Tracy 526* (type).

NEW MEXICO: Lincoln, *Earle.*

Gutierrezia linearis sp. nov.

Shrubby and branched; leaves linear, about 3 cm. long, 1–2 mm. wide, puberulent and viscid, punctate; heads 5–6 mm. high; involucres campanulate, slightly turbinate at the base; bracts scarious-margined; the outer ovate or obovate, the inner elliptic, obtuse; inflorescence corymbiform; ray- and disk-flowers each 3–4.

This species resembles *G. longifolia* in habit but has the head of *G. diversifolia*. It grows at an altitude of 1800–2300 m.

NEW MEXICO: Gray, Lincoln County, 1900, *Earle 474* (type).

COLORADO: Gunnison, 1901, *Baker 821;* Red Rock Cañon, 1896, *E. A. Bessey.*

Gutierrezia scoparia sp. nov.

Woody only at the base; flowering herbaceous branches numerous, about 3 dm. high, puberulent, mostly simple up to the inflorescence; leaves linear, 3–5 cm. long, 1–2 mm. wide, puberulent; inflorescence corymbiform; involucre oblong-turbinate, over 5 mm. high; outer bracts lanceolate, inner oblong; disk- and ray-flowers each about 4.

This is closely related to *G. diversifolia*, but has a longer, more turbinate involucre and narrower bracts. It grows at an altitude of 1500–2100 m.

COLORADO: Manitou, 1901, *Clements 16* (type); Boulder, 1902, *Tweedy 4888.*

Chrysopsis caudata sp. nov.

Perennial, with a thick tap-root and a very short, erect and much-branched caudex; stems many, erect, purplish, hirsute with long white hairs; lower leaves oblanceolate, tapering into a short petiole, silky-strigose on both sides, 3–5 cm. long; middle leaves similar but sessile, uppermost elliptic or oblong; heads congested in small clusters at the end of the branches and subtended by the uppermost leaves; bracts linear-lanceolate, hirsute, the innermost with a subulate usually brownish and spreading tip; disk about 15 mm. wide; rays bright yellow, about 12 mm. long and 3 mm. wide.

This species is closely related to *C. villosa*, but differs in the sessile heads subtended by oblong leaves and in the subulate tips of the involucral bracts. It grows on hills at an altitude of 1500–2950 m.

COLORADO: Ruxton Dell, 1901, *Clements 143* (type); near Boulder, 1902, *Tweedy 4897*.

Chrysopsis amplifolia sp. nov.

Perennial, with a tap-root, rather simple; stem 3–5 dm. high, often branched, pubescent and sparingly hirsute; lower leaves spatulate, strigose, obtuse or slightly mucronate, middle and upper leaves broadly oblong or elliptic; the upper cordate or truncate at the base, 3–4 cm. long, 12–15 mm. wide; inflorescence corymbiform; heads usually subtended by oblong leaves; bracts hirsute-strigose, linear-lanceolate, acute; disk 15 mm. or more wide; rays golden yellow, about 12 mm. long and 2.5 mm. wide; achenes densely strigose-canescent.

This is also closely related to *C. villosa*, but distinguished by the ample upper stem-leaves with subcordate or truncate bases and the large sessile heads. It grows on plains and foothills at an altitude of about 1500 m.

COLORADO: Longmont, 1902, *Tweedy 4898* (type); Ward, 1901, *Osterhout 2444*.

Chrysopsis horrida sp. nov.

Perennial with a tap-root, more or less cespitose; stems about 2–3 dm. high, hirsutulous and hispid, more or less branched, especially above; leaves obovate, broadly oblanceolate or oblong, subsessile, except the lower, densely hirsute with short hairs and slightly glandular-puberulent; heads corymbose, peduncled, about 8 mm. high; disk 1 cm. or less wide; rays about 8 mm. long and 1–1.5 mm. wide; achenes 2 mm. long, canescent; pappus about 5 mm. long, yellowish.

This has been taken for *C. hispida*, but the original *Diplopappus hispidus* Hook. is less hairy with longer hairs and more viscid; the leaves are narrowly oblanceolate and petioled and the heads larger, the disk being 12–15 mm. wide. *C. horrida* grows on dry hills and plains at an altitude of 1200–1600 m.

Colorado: New Windsor, 1900, *Osterhout 2326* (type), and 1901, *2362*; Platte, *Frémont.*

Nebraska: Pumpkin Seed Valley and Lawrence Fork, 1891, *Rydberg 141.*

Chrysopsis alpicola sp. nov.

Cespitose perennial; stems about 1 dm. high, silky-villous, numerous; leaves oblanceolate, about 3 cm. long; nearly all petioled, white-silky strigose or the pubescence more spreading on the petioles; heads solitary, subsessile, about 1 cm. high; bracts linear-lanceolate, hirsute, acute; disk about 12 mm. in diameter; rays about 8 mm. long and 2 mm. wide; achenes white silky-hirsute.

This is perhaps most closely related to *C. Bakeri*, but is much lower, more silky, with sessile heads and more hirsute involucre. It grows on the higher mountains, at an altitude of about 3500 m.

Colorado: Clark's Peak, 1896, *Baker.*

Solidago rubra sp. nov.

Stout, about 3 dm. high; stem pubescent or at the base merely puberulent, reddish; basal and lower cauline leaves broadly oblanceolate, 6–12 cm. long, firm, bluish-green, glabrous, pinnately veined, serrulate and minutely scabrous on the margins, acute, petioled; upper stem-leaves sessile and lanceolate; inflorescence paniculate but very narrow and elongated; heads about 8 mm. high and as broad; bracts narrowly linear-lanceolate, acute, ciliolate on the margin; rays rather pale yellow, about 4 mm. long and 0.7 mm. wide; achenes strigose.

This species is related to *S. scopulorum*, but is distinguished by the stouter habit, the broad leaves, the compound and dense inflorescence.

Colorado: North Park, 1899, *Osterhout 5.*

Solidago laevicaulis sp. nov.

Rather tall, 4–7 dm. high; stem glabrous up to the inflorescence, light-colored and shining; basal leaves narrowly oblanceolate, indistinctly if at all triple-nerved, rather thin, obtuse, 5–10 cm. long, entire or crenate above, glabrous except the scabrous margin; lower stem-leaves similar; upper stem-leaves narrowly lanceolate, sessile; inflorescence paniculate, but rather narrow, with numerous heads; branches nearly erect; heads about 8 mm. high; bracts narrowly linear-lanceolate, acute, ciliolate on the margin; disk about 8 mm. wide; rays numerous, about 4 mm. long and nearly 1 mm. wide; achenes sparingly strigose.

This is nearest related to the preceding, but taller and more slender, with narrower leaves and glabrous stem. It approaches the *S. serotina* group but has neither triple-nerved leaves nor secund branches. It grows in the mountains of Colorado and southern Wyoming at an altitude of 2500–3300 m.

COLORADO: North Park, 1899, *Osterhout 4* (type); Berthoud Pass, 1903, *Tweedy 5857*.

WYOMING: Copperton, 1901, *Tweedy 4009*.

Solidago radulina sp. nov.

Perennial; stem 3–4 dm. high, grayish-puberulent; basal and lower cauline leaves spatulate, obtuse, crenate at the apex, finely puberulent; upper stem-leaves elliptic or spatulate, acute; inflorescence narrow and elongated, paniculate; heads about 4 mm. high; bracts oblong, obtuse, or the inner linear, ciliolate on the margin; rays about 2.5 mm. long, 1 mm. wide; achenes hirsutulous.

This species is intermediate between *S. nana* and *S. pulcherrima*, but differs from the former in the taller habit and the elongated inflorescence and from the latter in the broader and shorter stem-leaves. In leaf-form it resembles somewhat *S. radula*, but is a smaller plant, with smaller leaves and narrow inflorescence, the branches of which are short and only somewhat secund. The type grew at an altitude of 1800 m.

UTAH: Cottonwood Cañon, 1869, *Watson 558* (type in herb. Columbia University).

COLORADO: Meadow Park, 1895, *Shear 5049*.

Solidago serra sp. nov.

Perennial with a rootstock; stem simple up to the inflorescence, about 6 dm. high, more or less pubescent especially above; leaves lanceolate, about 8 cm. long, acuminate, sharply toothed, rather thin, glabrous on both sides; inflorescence paniculate; branches arching and secund; heads numerous, 3–4 mm. high; bracts linear or linear-lanceolate, acute; rays 1–1.5 mm. long, less than 0.5 mm. wide; achenes hirsutulous.

This is closest related to *S. canadensis*, but differs in the glabrous leaves and the less pubescent stem. It may also be confused with *S. serotina* and *S. elongata*, but the former has much larger heads, fully 5 mm. high, and in the latter the inflorescence is narrower, rhombic in outline and with ascending scarcely arched branches.

COLORADO: Yampa, 1898, *Shear & Bessey 5274* (type).

WYOMING: Copperton, 1901, *Tweedy 4007*.

Solidago polyphylla sp. nov.

Tall, sometimes a meter high; stem strict, simple and puberulent up to the more hirsutulous inflorescence; leaves narrowly lanceolate, sessile, acute at the base, acuminate at the apex, distinctly triple-nerved, serrate above the middle with small distant teeth, thick and firm, green, scabrous above, more softly short-pubescent beneath; inflorescence panicled; branches more or less arching and secund; heads about 5 mm. high; bracts linear, acute; rays 1.5–2 mm. long, 0.5 mm. wide; achenes hispidulous.

This species is closely related to *S. procera* and has been mistaken for it. It differs from that species in the larger heads (in *S. procera* only 3–4 mm. high), the more compact inflorescence, the more toothed upper leaves and the shorter pubescence on the stem and lower leaf-surfaces.

COLORADO: Cañon City, 1896, *Clements 295* (type); Gunnison, 1901, *Baker 899;* Engelmann Cañon, 1901, *Clements 400.*

NEW MEXICO: Roswell, 1900, *Earle 346.*

Solidago viscidula sp. nov.

Low, about 2 dm. high; stem finely pubescent, reddish; basal leaves and lower stem-leaves narrowly linear-oblanceolate, finely puberulent and somewhat viscid, denticulate, obtuse or acutish, indistinctly triple-veined; upper stem-leaves sessile; inflorescence paniculate but flat-topped, branches scarcely secund; heads numerous, small, about 5 mm. high; bracts linear, obtusish, viscid; rays pale, about 2 mm. long and 0.5 mm. wide.

This is closely related to *S. missouriensis*, but is distinguished by the viscid inflorescence and the indistinctly triple-nerved leaves.

COLORADO: Grand Lake, 1888, *Holway.*

Oligoneuron canescens sp. nov.

Solidago rigida humilis Porter Syn. Fl. Colo. 63, 1874. Not *S. humilis* Mill.

Stout perennial; densely yellowish-canescent throughout; stem simple up to the inflorescence, 5–7 dm. high; basal leaves long-petioled; blades oval, 7–12 cm. long, thick, canescent on both sides, in age scabrous, distantly crenulate with small callous teeth; upper stem-leaves oval, sessile, entire or sinuate, crenulate, very densely canescent; inflorescence corymbiform but much congested; heads about 1 cm. high; bracts oblong, striate, canescent; rays 3–4 mm. long, less than 1 cm. wide, light yellow; achenes slightly hairy above, otherwise glabrous.

This differs from *O. rigidum* Small (*Solidago rigida* L.) in the shorter leaves, the smaller and denser inflorescence, the dense yellowish-canescent pubescence, and the achenes which are apparently always slightly hairy above. It grows on prairies and in valleys at an altitude of 900–1800 m.

WYOMING: Buffalo, 1900, *Tweedy 3117* (type); Dayton, 1899, *Tweedy 2017;* Devil's Tower, 1899, *L. W. Carter.*

NEBRASKA: Plummer Ford, Dismal River, 1892, *Rydberg 1666.*

SOUTH DAKOTA: Custer, 1892, *Rydberg 769.*

NORTH DAKOTA: Tower, 1891, *Wright.*

Chrysothamnus patens sp. nov.

Shrubby, half a meter or so high; stems white-tomentulose when young, soon glabrous and yellowish green; leaves 6–8 cm. long, about 1 mm. broad, soon glabrous, spreading or even reflexed; bracts lanceolate, acute, carinate, glabrous, in 5 vertical rows of about 3 each; corolla-lobes about 1 mm. long, lanceolate, acute, in age more or less spreading; achenes strigose.

This is closely related to *C. graveolens*, but differs in the narrow, spreading leaves. It grows on dry hills at an altitude o 1300–2100 m.

COLORADO: 1873, *Wolf 452* (type); Grand Junction, 1901, *Underwood & Selby 498b;* 1900, *Stokes;* Manitou, 1900, *Clements;* Alamosa, 1896, *Shear 3753;* Zola, 1901, *Baker 668.*

Chrysothamnus Newberryi sp. nov.

Shrubby below; stem white-tomentose, rather slender; leaves erect, linear-filiform, 1-nerved, slightly tomentulose when young;

the upper smaller; involucres turbinate; bracts in about 5 vertical rows, usually 3 in each row, narrowly lanceolate, attenuate into a long slender subulate spreading tip, carinate, slightly tomentulose and webby; achenes narrow, tapering downwards, strigose-pubescent; corolla narrowly tubular-funnelform; lobes erect, lanceolate.

This species is closely related to *C. Parryi* and *C. Howardi*, but the former differs in the broad, 3-nerved leaves and broader bracts, and the latter by its spreading arcuate leaves, broader bracts, depressed habit and elongated upper leaves, which usually equal or exceed the heads. *C. Newberryi* grows on dry hills.

NEW MEXICO: Cañon Largo, 1859, *Newberry* (Macomb's Expedition; type in herb. Columbia University).

COLORADO: Mesa Verde, 1892, *Eastwood.*

Sideranthus annuus nom. nov.

Aplopappus rubiginosus A. Gray, Syn. Fl. **1**^{2}: 130. 1884. Not Torr. & Gray, Fl. **2**: 240. 1842.

A little comparison between the descriptions of *A. rubiginosus* in Torrey and Gray's Flora and in Gray's Synoptical Flora will show that they are drawn from different plants. The first line in Torrey and Gray's description, viz. "suffruticose? branching from the base, viscidly pubescent and cinereous" and further down "scales of the involucre . . . in about 2 series, nearly equal, loose, at length spreading" do not at all fit the plant of the upper Platte, for that plant is strictly annual, simple at the base and branched above, viscid but can hardly be called cinereous; the bracts are in 4 or 5 series, well imbricated and the outer much shorter. The type of *Aplopappus rubiginosus* was collected by Drummond, and a specimen is in the Gray herbarium. This is very unlike the plant of the upper Platte region, which is described in Gray's Synoptical Flora, but agrees fully with the description of Torrey and Gray. It is more closely related to *A. phyllocephalus* DC., but perhaps distinct.

Aster griseolus sp. nov.

Perennial with a horizontal rootstock; stem 1–1.5 dm. high, hirsute with ascending hairs, rather simple; leaves linear, 3–5 cm. long, sparingly hairy on both sides, sessile, acute, entire; heads about 1 cm. high, 1–4 in a small corymb; bracts oblanceolate or linear, the outer obtuse, the inner acute, green or the inner white on the sides below, pubescent on the back, but not bristle-pointed; rays purple, about 8 mm. long and 1 mm. wide; achenes pubescent.

This is nearest related to *A. griseus* Greene, but differs in the small size, the narrow short sessile leaves, and the pubescence which is not reflexed on the lower part of the stem. *A. griseolus* grows on the higher mountains of Colorado.

COLORADO: Mt. Harvard, 1896, *Clements 37* (type); Twin Lakes, 1896, *Shear 3499*.

Aster Underwoodii sp. nov.

Perennial with a horizontal rootstock; stems simple up to the inflorescence, 2–3 dm. high, often purplish, more or less hirsute-strigose; lower leaves spatulate or oblanceolate, tapering into a winged petiole, glabrous except the ciliolate margin or slightly pubescent when young; the other stem-leaves sessile and the uppermost linear-lanceolate; inflorescence racemiform or corymbiform with 4–8 heads; these fully 1 cm. high; bracts oblanceolate, the outer obtuse, the inner acutish, all with a rather thick green tip, pubescent on the back; rays purple or bluish, about 1 cm. long and 1–1.5 mm. wide; achenes hirsute.

This is related to *A. adscendens* and *A. Nelsonii*. From the former it differs in the hairy bracts and from the latter in the broad leaves. It suggests also *A. griseus*, but has shorter and almost glabrous leaves. It grows at an altitute of 2500–3000 m.

COLORADO: Ironton Park, 1901, *Underwood* and *Selby 318* (type); Eldora to Baltimore, 1903, *Tweedy 5831*.

Aster Osterhoutii sp. nov.

Tall, branched and leafy, about 1 mm. high; stem striate, glabrous below, hairy in decurrent lines above; leaves linear or linear-lanceolate, 5–12 cm. long, 8 mm. wide or less, scabrous-ciliolate on the margin, otherwise glabrous, entire-margined, sessile and half clasping; those of the branches much smaller; inflorescence open-paniculate; heads nearly 1 cm. high; bracts in 4–5 series, the inner linear, acute, the outer oblanceolate, apiculate, green and with white margins below; rays white or rarely pinkish, nearly 1 cm. long and fully 1 mm. wide.

This species is related to *A. salicifolius*, but differs in the narrow, thin, entire leaves. Mr. Fernald, to whom some of the specimens had been sent, named it *A. salicifolius caerulescens* Gray, but that has very narrow, linear outer bracts and usually purplish or bluish rays. *A. Osterhoutii* grows along ditches at an altitude of about 1500 m.

Colorado: New Windsor, 1899, *Osterhout 2506* (type); also 1898, *9*, and 1900, *2328*.

Aster corymbiformis sp nov.

About 3 dm. high; stem strict, branched above, pubescent on decurrent lines; leaves linear, 5–8 mm. long, scabrous on the margins, otherwise usually perfectly glabrous, half-clasping; inflorescence leafy, corymbiform; heads about 8 mm. high; bracts linear-lanceolate, very acute, glabrous, rather firm, with an oblanceolate green tip, in about 3 series of nearly equal length; rays white or purplish, about 7 mm. long and 1 mm. wide.

This is perhaps nearest related to *A. paniculatus*, but in habit reminding somewhat of *A. adscendens*. From the former it differs in the strict habit, the corymbiform inflorescence and the entire leaves. From *A. adscendens* it differs in the more numerous heads and the bracts, the outer of which at least are oblanceolate and obtuse in *A. adscendens*.

Colorado: West Cliff, 1896, *Shear 3460* (type); also *3813* and *3819*; Parlin, Gunnison Co., 1901, *B. H. Smith 114* and *116* (?).

Aster Tweedyi sp. nov.

Perennial with a horizontal rootstock; stem simple, usually purplish, pubescent only on decurrent lines, about 4 dm. high; leaves oblanceolate, acute, glabrous except the ciliate margin, rather firm, often 1 dm. long; the lower with a winged petiole; the upper sessile and half clasping; inflorescence paniculate, leafy; heads about 1 cm. high; bracts in about 3 series, linear or oblanceolate, not very unequal in length, the outer mostly green and obtuse, the inner with green tips and midrib, whitish on the sides below; rays rose or purple, 8–10 mm. long and 1.5 mm. wide.

This species is related to *A. adscendens* but differs in the stouter habit, broader and firmer leaves and larger heads. It grows in valleys at an altitude of 1500–2600 m.

Wyoming: Copperton, 1901, *Tweedy 4096* (type); Big Horn Mountains, 1899, *Tweedy 2523*; Laramie, 1897, *Elias Nelson 152*.

Colorado: Laramie River, Larimer County, 1897, *Osterhout 2518*.

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CHEMICAL STIMULATION OF A GREEN ALGA

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INTRODUCTORY

That certain activities of plants, notably that of growth, are accelerated by many mineral poisons when the latter are applied in very great dilution has long been known in a general way. The nature of this toxic stimulation and how it is brought about are, however, as little known as are the vital functions themselves. Indeed, until very recently no quantitative data have been available regarding such responses, either in plants or animals. Thus it appeared worth while to undertake a comparative study of toxic stimulation, using a single form of plant and as large a number of poisons as possible. The present paper embodies the results of the first section of this problem, and deals with the effects of what are termed the positively charged ions from dissociated mineral salts.

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* The principal part of the investigations described in this paper was carried on at the New York Botanical Garden by the aid of a research scholarship from that institution during September to December, 1903.

In the following pages the term *stimulation* will be used to denote any catalytic effect upon vital activity, brought about by any change of the conditions under which the organism is living. Thus, any substance which, upon entering the protoplasm, causes either an acceleration or a retardation of certain functions, is a stimulating agent. Death itself, when it results from poisons at least, is merely the last of a series of stimulation responses, or, rather, it is the final summation of such responses, and appears as a single one only because we have not yet been able to unravel the vast tangle of activities of which it is the resultant.

Two ends must be held in view in a research of this kind. First, analysis is to be made of the conditions which bring about the response, and determination of their manner of action. Second, knowing in this way something of the sets of conditions which stimulate, it will eventually be possible, it is hoped, to interpret the latter so as to throw light upon the nature of the stimulated processes themselves. It is by this means that we may hope to gain more definite knowledge of the complex system of energy changes which make up vitality. Thus the problem may be approached in somewhat the same manner as that in which the chemist attacks a new organic compound, by studying in a quantitative way the effects of various reagents upon it. In this case of the chemist, the reagents are at least better known than the body to which they are applied, and the same must be true in physiological work. For a study of toxic stimulation, a knowledge of reagents comes, of course, from the realm of physics and chemistry.

The organism used in the experiments here described is the same form of *Stigeoclonium* whose responses to changes in external osmotic pressure were worked out some time ago.* A brief

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* Livingston, B. E. On the nature of the stimulus which causes the change of form in polymorphic green algae. Bot. Gaz. 30: 289–317. 1900. — Further notes on the physiology of polymorphism in green algae. Bot. Gaz. 32: 292–302. 1901. — The rôle of diffussion and osmotic pressure in plants 132–137. Chicago. 1903. (These pages are included in the reprint of the last chapter of the volume, entitled, The influence of the osmotic pressure of the surrounding medium upon organisms. Chicago. 1903.) A portion of the résumé here given is taken from the last reference.

résumé of the previous results is here given. In nutrient media whose osmotic pressure is from 323.7 cm. to 647.4 cm. of mercury, the alga appears as groups of spherical cells with thickened and somewhat gelatinous walls. Multiplication takes place rather slowly, cell-division occurring in all directions, and the daughter cells immediately become spherical, so far as this is not prevented by adjacent cells. Often this process of rounding off results in the entire separation of cells, so that a culture of this sort usually exhibits numerous free cells of perfectly spherical form. In weaker solutions, whose pressure is below 161.8 cm. of mercury, the daughter cells elongate into branching filaments composed of cylindrical cells and having the typical appearance of the smaller forms of the genus *Stigeoclonium.* Growth is more rapid here than in the strong solutions. If filaments are transferred to a strong solution their cells round up and often separate, thus producing the other form, and growth continues in the manner first described. In the weak solutions zoöspores are formed in great numbers and germinate to form filaments; in the strong solutions they are not formed at all, and if transferred to such media they fail to germinate, many of them, however, passing by direct enlargement to the conditions of free spherical cells which later behave in accordance with the pressure of the medium, as outlined above. The biciliate zoöspores are produced by simple segmentation of the entire cell-contents, which are freed by a final bursting of the sporangium wall.

A resting zoöspore and several stages in the germination of these bodies are shown at *a*, *fig. 1*; at *b* is shown a more mature filament, as these normally occur floating on the surface of the weak solution; while at *c* is shown a form with more crowded branches, which is usually exhibited on the bottom of the culture dish, where air has not such free access. The spherical form, known usually in such algae as the palmella form, is shown in *fig. 2*. The groups of cells at *a* and *c* have developed from filaments which were transferred from a weak to a strong solution. The filamentous form is still to be seen in both groups, although it has well nigh disappeared in the lower. At *b* are some free cells in process of division which would result in groups of the palmella form.

This investigation was begun and about half finished in the laboratories of the New York Botanical Garden, where it was my good fortune to hold a research scholarship during the autumn of 1903. Through the kindness of the Director in Chief and of the Director of the Laboratories, the facilities for the work were practically unlimited. The experiments were completed at the Hull Botanical Laboratory of the University of Chicago during the winter and spring just passed.

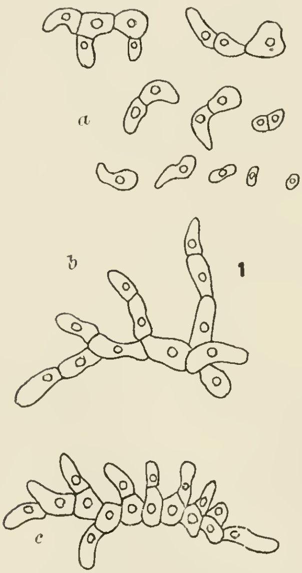

FIGURE 1. Normal filaments, from weak nutrient solution.

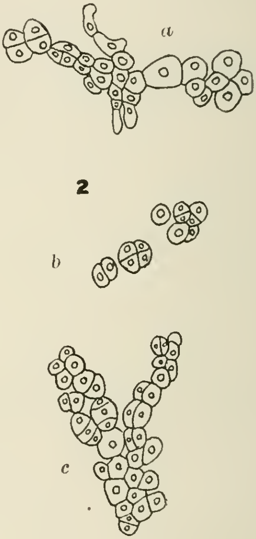

FIGURE 2. Normal palmella, from strong nutrient solution.

METHODS

A modification of the well-known Knop's nutrient solution was used as a basis for the culture media and for the controls. The differences between this and the true Knop's solution are such as to make the former more easy of preparation when the chemistry of the mixture is to be considered. The formula, and certain physical properties of this standard culture medium are shown in the following table. The concentration data for the salts are given in terms of a normal solution, *i. e.*, one gram equivalent per liter of solution.* The osmotic pressure data are computed from Δ_f, the lowering of the freezing point below that of distilled water †, measured in Centigrade degrees.

FORMULA AND OSMOTIC PRESSURE OF NUTRIENT MEDIUM

Salts	Concentration.	Lowering of freezing pt. (Δf)	Osmotic pressure.		
			mm. Hg.	Atmospheres	M.
$Ca(NO_3)_2$	15*n*/10,000	0.006°C.	60.09	0.079	0.0035
KNO_3	4*n*/10,000				
$MgSO_4$	4*n*/10,000				
K_2HPO_4	4*n*/10,000				
$Fe(NO_3)_2$	*n*/100,000				

The above solution was made up from normal solutions of the component salts. Practically no $Ca_3(PO_4)_2$ is precipitated if the K_2HPO_4 is added to the other salts only after the addition of nearly all the required water.

In the control medium just described the alga takes the filamentous form, and zoöspores are plentiful. For the palmella form a solution of one hundred times the strength of this was used. The iron salt, however, was not increased in amount.

On account of the extreme complexity of the general question of toxic stimulation, it seemed expedient to work with but one of the two forms of this alga. By the use of poisons it has been so far impossible to cause a strong solution to produce other than the palmella form, but weak solutions can be made to produce this form at will, as will be shown in this paper. Therefore the filamentous form was chosen as the most responsive and thus the best suited to the work in hand.

On account of the well-known toxicity of certain metals, and in order to simplify the otherwise almost hopelessly complicated methods, the problem was further restricted by confining attention to the cations * alone. In order to do this it was necessary to use as stimulating agents salts whose anions were already present in the control solution described above. Soluble nitrates and sulfates were chosen for this purpose. Normal or decinormal solutions of these salts were made up as accurately as possible, and these were diluted to the concentrations needed for the cultures. Since the addition of the poison to the nutrient solution would necessarily dilute both solutions to some degree, the following method of mutual dilution was adopted. The nutrient solution was made up to nine-tenths of its required volume, while the poison solution for each culture was prepared ten times its required concentration, or one tenth of its required volume. Thus, for control culture, 9 c.c. of stock nutrient solution plus 1 c.c. of water was used, and for any concentration of poison (say kn, k being any fraction of normal), the culture medium was composed of 9 c.c. of nutrient solution plus 1 c.c. of 10 kn poison. An example will illustrate this: Suppose that it was desired to test the effect of $n/10,000$ H_2SO_4. 1.5 c.c. of $n/1$ $Ca(NO_3)_2$ was taken, together with 0.4 c.c. each of $n/1$ KNO_3 and $n/1$ $MgSO_4$, and 1.0 c.c. of $n/100$ $Fe(NO_3)_2$. After mixing, these were diluted to a volume of 899.6 c.c. and then there was added 0.4 c.c. of $n/1$ K_2HPO_4. A further addition of 100.0 c.c. of water would have produced the control medium. To 9.0 c.c. of this "9/10 dilution," was added 1.0 c.c. of $n/1000$ H_2SO_4. It is readily seen that through mutual dilution both sets of ions come to be of the desired concentration, the H_2SO_4 being now $n/10,000$. The slight increase in the osmotic pressure of the experiment solution over that of the control, due to the addition of the poison itself, is, in most cases, physically negligible (because of the extreme dilutions used), and is always physiologically so (because of the comparatively high concentration limits for the response of this form, as previously † determined). Poisons of as high concentration as $n/100$ have been used in only a few cases.

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* Throughout this paper the decimal system will be used to denote fractions of normal solutions rather than the cumbrous method of dilutions by one half commonly in use by chemists. One is easily reducible to the other, but it seems that for modern workers the decimal system is by far the better. The form of the common fraction is retained on account of a somewhat greater ease of reading.

† For the method of making this calculation, see Livingston, B. E. The rôle of diffusion and osmotic pressure in plants, 37 (Chicago, 1903), and the references given on that page and at the beginning of the volume. The osmotic pressure, in millimeters of mercury, of a solution at 25° C. (P_{25}) is approximately given by the formula: $P_{25}=10{,}014.84\ \Delta_f$. This quantity in terms of M (22.3 atmospheres, the calculated pressure of a molecular solution of a non-electrolytic and non-hydrating body) is given by the formula: $P_{25}=0.59\ \Delta_f$.

The poison salts added to the nutrient solutions were also

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*The terminology of the ionic theory is here used, merely because it is most convenient.

†Livingston, B. E. 1900 and 1901, *loc. cit.*

used in such dilution that the slight increase in NO_3 and SO_4 ions caused by the addition could have no effect upon the plant. To test this, variations in the amount of nitrate and sulfate were tried over a greater range than that required for the main series of experiments, but without any response in the plant. This is in agreement with the results published previously (*loc. cit.*, 1900), wherein the effect of a decrease of nine-tenths in the amount of any salt in Knop's solution and an increase in the other three main salts sufficient to keep the pressure constant, was found to be without response in the plant.

Kahlbaum salts were used throughout the work and the utmost pains were taken to have the concentrations correct. All water was distilled in block tin and redistilled in glass.

Pure cultures of the alga were made in the standard nutrient solution and from these the inoculations were make for the experiments. These inoculations were made with wood tooth-picks in place of the usual needle. Sterilization was found not to be necessary, there being no organic bodies in the solutions, and a new tooth-pick was used for each individual culture. Upwards of fifty cultures were usually made at a time, the poison solutions having been prepared in small bottles a day or two before and kept stoppered. The dishes used were the Bausch & Lomb glass culture dishes, about 4.5 cm. in diameter and 2.0 cm. high, with a lid fitting down upon a shoulder after the manner of a pill-box. Ten cubic centimeters of solution were used for each culture. At the New York Botanical Garden the experiments were carried on partly on glass shelves against the pane of an east window, partly in a cool experiment house, and partly on tables directly under a large skylight. At the Hull Laboratory they were placed on glass shelves against a west window. The alga does not require strong light and grows best at a comparatively low temperature. Thus an east or west window of a ordinary laboratory room is well suited for its growth. Cultures came to maturity somewhat earlier in the experiment house than in the laboratory. An experiment ran from twelve to twenty days, being examined *in the dish*, with the low powers of the microscope at critical times, — every day or two for the first few series.

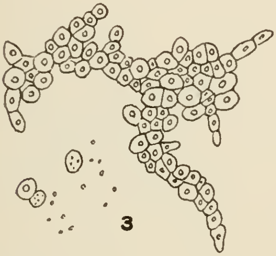
All of the data given are derived from cultures repeated several times. The number of the cultures amount to 1,048 in all.

EXPERIMENTATION

I. PRELIMINARY. — The responses of the filamentous form of this plant to toxic salts are of three somewhat distinct types: (1) death, (2) change in phenomena of growth, and (3) change in phenomena of reproduction. The fatal concentration was determined for most of the salts tested. At a concentration somewhat below the fatal strength, all of the salts cause the filaments to take the palmella form. That is, the presence of the toxic salt causes the plant to behave in this regard as though it had been placed in a solution of relatively high osmotic pressure. The cylindrical cells become spherical and division proceeds in the normal manner as described for the palmella form. But many of the salts also produce, at a certain concentration, another response, namely an acceleration in the production of zoöspores, so that a poisoned culture shows zoöspores sooner and in greater number than does the control without the poison. This often occurs at a concentration where only the palmella form is produced, and here the zoöspores cannot germinate as filaments. They act in this case as though they had been placed in a strong solution. Some of them die and others simply enlarge and become free palmella cells. These points will be discussed more fully farther on.

II. STATEMENT OF RESULTS. — Following is a description of the responses to the different reagents employed. The salts are arranged in alphabetical order according to the English name of the metal. The figures are all camera drawings and the magnification is about 300 diameters.

1. Aluminium nitrate ($Al_2(NO_3)_6$). — Filaments are all killed in *n*/10,000. In 5*n*/100,000 most of the cells die, but what few resist the poison for the first week develop into the palmella form. No zoöspores are produced. (See *fig. 4*, wherein are shown a parenchyma-like mass of cells, three groups of two cells each, and two single cells. Of one of the groups of two, one cell has died after making the palmella form, as is indicated by the granules within. The similar granules lying about the culture are remains of dead cells.) In a concentration of *n*/100,000 the majority of the cells become spherical or nearly so but a number still die. Also, there is here a marked production of zoöspores, which form spherical cells immediately after germination, usually by the time they have reached the two-celled stage. (See *fig. 5*. Here the dead filament-cells are denoted by dotted contents, the same methods will be used in the following figures. A number of empty sporangia are shown at *a*, together with zoöspores in various stages.) In weaker concentrations the filaments persist, zoöspore acceleration being still evident in $5n/1{,}000{,}000$. In $n/1{,}000{,}000$ the culture is normal for a weak solution. Here zoöspores are produced but not as soon nor in such great number as in the stimulated cultures.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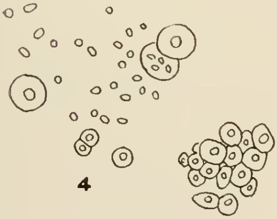
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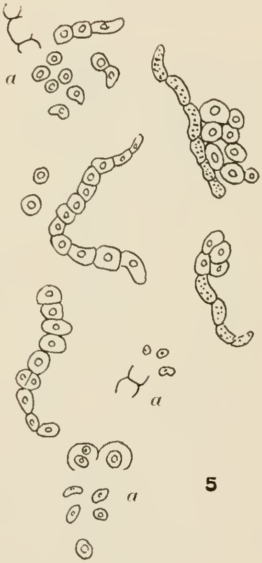

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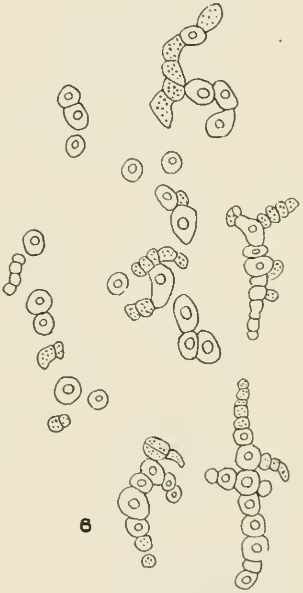
FIGURE 3. Palmella and dead cells from $5n/100{,}000$ $Al_2(SO_4)_3$.
FIGURE 4. Palmella and dead cells from $5n/100{,}000$ $Al_2(NO_3)_6$.
FIGURE 5. Palmella and zoöspores from $n/100{,}000$ $Al_2(NO_3)_6$.

2. *Aluminium sulfate* ($Al_2(SO_4)_3$). — This salt acts in the same way as does the nitrate, and at the same concentrations. (See *fig. 3*, showing a large group of palmella still exhibiting traces of

the filamentous form from which it came, and several dead cells with granular remains of others.)

3. Ammonium nitrate (NH_4NO_3). — The killing strength was not determined ; it lies above *n*/100. In the last named concentration a large proportion of the cells die, the remainder becoming palmella. The same is true of *n*/1,000 but more cells live. (See *fig. 6*, showing palmella cells arising from cylindrical filamentous ones, by the survival of the most resistant, apparently.) In 5*n*/10,000 and 6*n*/10,000, the palmella form is still more or less apparent, though good filaments usually persist. There is in the last named strengths an acceleration of zoöspore production, as in the aluminium salts. At *n*/10,000 all traces of palmella form are lost and the zoöspore activity has sunk to normal, *i. e.*, this strength gives the usual growth for a solution of low osmotic pressure.



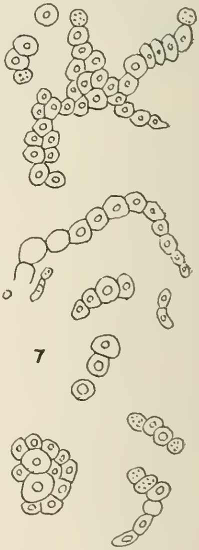


FIGURE 6. Palmella and dead cells from *n*/1,000 NH_4NO_3.

FIGURE 7. Palmella, traces of filaments, sporangia, and zoöspores, from 5*n*/10,000 $(NH_4)_2SO_4$.

4. Ammonium sulfate ($(NH_4)_2SO_4$). — The results are the same as for the nitrate. (*Fig. 7* shows palmella, several fairly typical filamentous cells, and sporangia.)

5. Barium nitrate ($Ba(NO_3)_2$). — With this salt, *n*/100 kills practically all cells, although sometimes a few of the palmella form will survive. The palmella form is typically produced in 5*n*/1,000, and more slowly in *n*/1,000. In 5*n*/1,000 to some extent, but especially in *n*/1,000, there is again an acceleration of zoöspore production, which activity falls back to normal at a concentration of 5*n*/10,000.

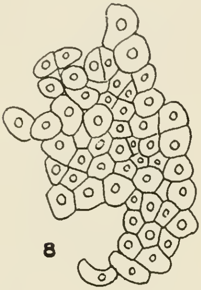
6. Calcium nitrate ($Ca(NO_3)_2$). — This salt is a component of the nutrient solution itself and therefore it is difficult to determine its effect upon the plant without having recourse to other methods than the ones here used. The experiments indicate that it produces palmella at 5*n*/100, and that there is a zoöspore acceleration from *n*/100 to 5*n*/1,000. The palmella response is perhaps partly due to osmotic pressure.

7. Cadmium nitrate ($Cd(NO_3)_2$). — The lowest dilution producing death to all cells is *n*/10,000, usually 5*n*/100,000 kills the majority of the cells. The typical palmella form is produced in concentrations of from 5*n*/100,000 to *n*/100,000, and zoöspore acceleration appears in the latter concentration and continues in weaker ones till the cultures become normal in the vicinity of 5*n*/1,000,000. It is often difficult to tell where acceleration of zoöspore production actually ceases; the markedly increased activity of the higher concentrations grades almost imperceptibly into the normal production of these bodies in the weaker ones.

8. Cobalt nitrate ($Co(NO_3)_2$). — The killing strength is from *n*/1,000 to 5*n*/10,000. The palmella form is produced in 5*n*/10,000 to *n*/100,000, and zoöspore stimulation at *n*/10,000 to 5*n*/1,000,000, below which concentration the cultures are normal. (*Fig. 8* shows palmella from *n*/10,000 concentration.)

9. Cobalt sulfate ($CoSO_4$). — The responses here follow accurately those with the nitrate. (*Fig. 9* shows palmella in 5*n*/1,000,000, while *fig. 10* shows nearly normal filaments in one fifth of that strength.)

10. Copper nitrate ($Cu(NO_3)_2$). — The killing strength is from *n*/100,000 to 5*n*/1,000,000. In the latter strength sometimes a few palmella cells remain. Filaments are inhibited, thus giving the palmella form, in strengths from 5*n*/1,000,000 to 5*n*/10,000,000. The palmella form in solutions of this salt is usually somewhat bluish green in color. There is an acceleration of zoöspore production at *n*/1,000,000. At *n*/10,000,000 the culture is normal.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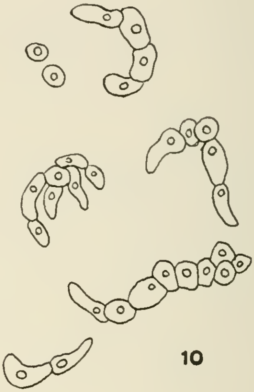
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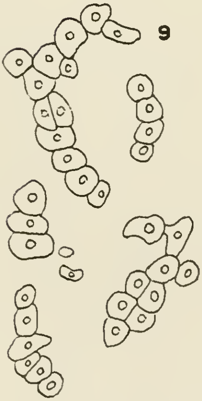
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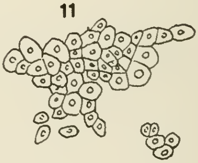
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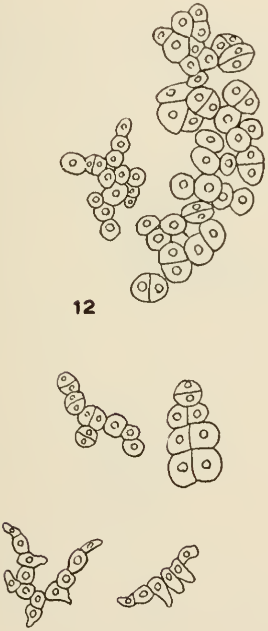
FIGURE 8. Palmella from *n*/10,000 $Co(NO_3)_2$.
FIGURE 9. Palmella and zoöspores from 5*n*/1,000,000 $CoSO_4$.
FIGURE 10. Filaments from *n*/1,000,000 $CoSO_4$.
FIGURE 11. Palmella from *n*/1,000,000 $Cu(NO_3)_2$.

(*Fig. 11* illustrates typical palmella from *n*/1,000,000 concentration.)

11. Copper sulfate ($CuSO_4$). — The sulfate again agrees with the nitrate. (*Fig. 12* shows the appearance of palmella in *n*/1,000,000, concentration.)

12. Hydrogen nitrate, nitric acid (HNO_3). — This body kills the plant at a concentration of 5*n*/10,000. Palmella is produced from *n*/10,000 to 6*n*/100,000, sometimes even in 3*n*/100,000. Acceleration of zoöspore production is exhibited from *n*/100,000 to 6*n*/100,000 or 3*n*/100,000, in certain cases, and below the last-named strength, at least at *n*/100,000, the alga appears normal. (See *fig. 13*, which shows palmella produced from filaments in a solution of 6*n*/100,000 concentration.)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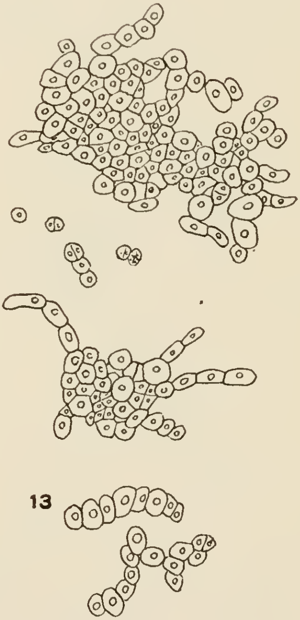
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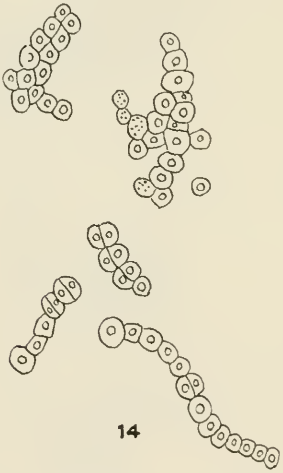
FIGURE 12. Palmella and some filaments changing to palmella, from *n*/1,000,000 $CuSO_4$.

FIGURE 13. Palmella from 6*n*/100,000 HNO_3.

13. Hydrogen sulfate, sulfuric acid (H_2SO_4). — This follows nitric acid very closely. There seems to be here sometimes a tendency for the palmella range to extend downward so to include *n*/100,000, but it was impossible to establish this for a certainty in all series. If it be so, it of course means that the sulfate is somewhat more active than the nitrate, and that the action in this case is not entirely to be attributed to the cation. This would agree with the results of certain other authors to be cited later. (*Fig. 14* shows palmella and dead cells from 3*n*/100,000.)

14. Iron nitrate (*ferric*) ($\mathrm{Fe_2(NO_3)_6}$). — The cells are all killed at *n*/10,000. They live as the palmella form in concentrations of from 8*n*/100,000 to 5*n*/100,000. At 7*n*/100,000 and 8*n*/100,000 zoöspore production is accelerated, and at 2*n*/100,000 and *n*/100,000 the growth is normal for weak solutions. For these tests iron was omitted from the nutrient medium to which the poison was added.

15. Lead nitrate ($\mathrm{Pb(NO_3)_2}$). — Death ensuses in *n*/10,000. In 5*n*/100,000, the majority of the cells die, but some become of the palmella form. The latter form is maintained through the series to 5*n*/1,000,000, in which solution there are usually a number of good filaments, although most of the culture is of spherical cells. Zoöspore acceleration occurs in *n*/100,000 to 5*n*/1,000,000. In *n*/1,000,000 to 5*n*/10,000,000, the growth of filaments and zoöspores is the same as in the control.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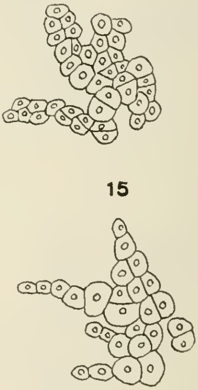
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FIGURE 14. Palmella and several dead cells from 3*n*/100,000 $\mathrm{H_2SO_4}$.
FIGURE 15. Palmella from *n*/1,000,000 $\mathrm{AgNO_3}$.

16. Lithium nitrate ($\mathrm{LiNO_3}$). — Many, but not all, of the cells die in 5*n*/100. The palmella form is produced from 5*n*/100 to

5*n*/10,000, with some acceleration of zoöspore production in *n*/1,000 to 5*n*/10,000. The acceleration is not as marked as in most of the other salts, however. Normal growth occurs in *n*/10,000 and weaker solutions.

17. Lithium sulfate (Li_2SO_4). — A thorough test of this salt was not made, but as far as the experiments were carried the results agree well with the data given for the nitrate.

18. Magnesium nitrate ($Mg(NO_3)_2$). — This cation is present in the nutrient medium. The experiments consisted in increasing its amount. 5*n*/100 does not kill, but produces the palmella form as does also *n*/100 and, to some extent, 5*n*/1000. Zoöspore acceleration occurs in *n*/100 and the normal behavior is exhibited in *n*/1,000 and still weaker solutions.

19. Magnesium sulfate ($MgSO_4$). — This salt agrees with the nitrate perfectly excepting that it was impossible to establish a true zoöspore acceleration here. Sometimes this phenomenon appears and at other times not. It appeared most often at *n*/100 concentration. Perhaps undissociated molecules have to do with this response, but no particular study was made here, this subject lying rather in the field of nutrient salts than in that of toxic ions.

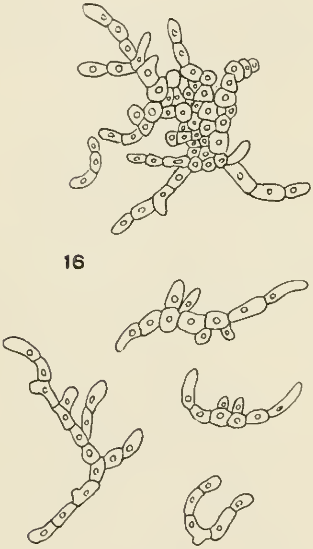
20. Nickel nitrate ($Ni(NO_3)_2$). — A concentration of *n*/10,000 produces death. Filaments are hardly at all present in 5*n*/100,000, practically all of the cells being of the other form, but in *n*/100,000 there is about an even mixture of the two forms. A rather slightly marked zoöspore acceleration occurs in *n*/100,000, and still less marked in weaker solutions. At a concentration of *n*/10,000,000 the alga is certainly uninfluenced by the poison. The zoöspore acceleration grades almost imperceptibly into the normal production of these bodies.

21. Potassium nitrate (KNO_3). — This salt is so common in the environment of plants that it would hardly be expected to produce very marked stimulation responses. It is probably less toxic toward plants in general than any other salt. At a concentration of 5*n*/100 the palmella form is produced. This is perhaps due, in part at least, to osmotic phenomena. No acceleration of zoöspore production was observed.

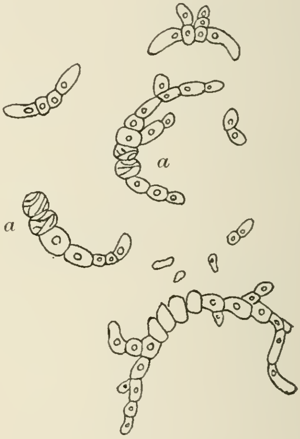
22. Potassium sulfate (K_2SO_4). — As far as could be determined, this salt acts exactly like the nitrate.

23. Rubidium sulfate (Rb_2SO_4). — The plant is killed by *n*/100 and to some extent by 5*n*/1,000. In 5*n*/1,000 and *n*/1,000 the palmella form is produced, with few or no zoospores, and the culture becomes normal at *n*/10,000. No acceleration of zoöspore production occurs here.

24. Silver nitrate ($AgNO_3$). — Death occurs from *n*/100,000 to 6*n*/1,000,000. Filaments do not appear in *n*/1,000,000, but begin to survive in 5*n*/10,000,000, where also there is an increase in the number of zoöspores. The cultures are normal or slightly accelerated as to zoöspore activity, in *n*/10,000,000. (See *figs. 15, 16*, and *17*. The former shows typical palmella form in *n*/1,000,000, the second a mixture of palmella and filamentous forms in 5*n*/10,000,000, and the last a normal filamentous culture in *n*/10,000,000. Zoösporangia are shown at *a*.) The limits are quite sharply defined for this salt.



16



17

FIGURE 16. Palmella and filaments from 5*n*/10,000,000 $AgNO_3$.
FIGURE 17. Normal filaments and zoösporangia (*a*), from *n*/10,000,000 $AgNO_3$.

25. Sodium nitrate ($NaNO_3$). — This cation is but little more poisonous than potassium. The palmella form is produced in

5*n*/100 to *n*/100, with filaments also quite well developed in the last-named strength. Osmotic pressure probably begins to play some part here. The killing concentration was not determined. There is little if any acceleration of zoöspore production. Cultures appear normal in *n*/1,000.

26. Sodium sulfate (Na_2SO_4). — This follows the last-named salt accurately as far as was determined.

27. Strontium nitrate ($Sr(NO_3)_2$). — This cation is very slightly toxic, so that here again osmotic phenomena begin to play a part before a stimulating concentration is reached. The killing strength was not determined. The palmella form is produced typically in 5*n*/100, and there is unquestionably an acceleration in zoöspore production in 5*n*/1,000, in which the zoöspores develop into short filaments but are destroyed rapidly by the formation of zoösporangia. The cultures are normal at *n*/1,000 and below.

28. Uranyl nitrate ($UO_2(NO_3)_2$). — Death occurs here in *n*/10,000 or stronger, the spherical form appears in 5*n*/100,000 and is found mixed with filaments in *n*/100,000. Acceleration of zoöspore production is exhibited in *n*/100,000 and in 5*n*/1,000,000, while normal growth occurs in *n*/1,000,000 and below.

29. Zinc nitrate ($Zn(NO_3)_2$). — In 5*n*/10,000 death ensues, in *n*/10,000 about one half of the cells die, the rest take the palmella form. In 5*n*/100,000 both filaments and palmella occur and zoöspores are more numerous than in the control, while in *n*/100 growth is the same as in the control.

30. Zinc sulfate ($ZnSO_4$). —The sulfate of this metal acts like the nitrate, excepting that here again an acceleration of zoöspore activity could not be established.

These results will now be brought together in tabular form. In the table which follows, the salts are arranged in the same order as in the foregoing description. In the first column after the name of the salt, occurs the lowest concentration producing death. In the second column are placed the concentrations at which filaments change to the other form. The strengths at which zoöspore production is accelerated are shown in column four, and that at which growth becomes normal is expressed in the last column.

TABLE OF RESULTS

Salt.	Lowest fatal concentration.	Filaments become palmella.	Acceleration of zoöspore production.	Normal filaments.
$Al_2(NO_3)_6$	n/10,000	5n/100,000 n/100,000	n/100,000 5n/1,000,000	n/1,000,000
$Al_2(SO_4)_3$	“	“	“	“
NH_4NO_3	?	n/100 5n/10,000	5n/10,000 6n/10,000	n/10,000
$(NH_4)_2SO_4$	?	“	“	“
$Ba(NO_3)_2$	n/100	5n/1,000 n/1,000	5n/1,000 n/1,000	5n/10,000
$Ca(NO_3)_2$	?	5n/100	n/100 5n/1,000	?
$Cd(NO_3)_2$	n/10,000	5n/100,000 n/100,000	n/100,000	5n/1,000,000
$Co(NO_3)_2$	n/1,000	5n/10,000 n/100,000	n/10,000 5n/1,000,000	n/1,000,000
$CoSO_4$	“	“	“	“
$Cu(NO_3)_2$	n/100,000	5n/1,000,000 5n/10,000,000	n/1,000,000	n/10,000.000
$CuSO_4$	“	“	“	“
HNO_3	5n/10,000	n/10,000 6n/100,000	n/100,000 6n/100,000	n/100,000
H_2SO_4	“	n/10,000 n/100,000 (?)	“	“
$Fe_2(NO_3)_6$	n/10,000	8n/100,000 5n/100,000	7n/100,000 8n/100,000	2n/100,000
$Pb(NO_3)_2$	n/10,000	5n/100,000 5n/1,000,000	n/100,000 5n/1,000,000	n/1,000,000
$LiNO_3$	?	5n/100 5n/10,000	n/1,000 5n/10,000 (slight)	n/10,000
Li_2SO_4	?	“	“	“
$Mg(NO_3)_2$	?	5n/100 n/100	n/100	n/1,000
$MgSO_4$	?	“	n/100 (?)	“
$Ni(NO_3)_2$	n/10,000	5n/100,000	n/100,000	n/10,000,000
KNO_3	?	5n/100	No acceleration.	?
K_2SO_4	?	“	No acceleration.	?
Rb_2SO_4	n/100	5n/1,000 n/1,000	No acceleration.	n/10,000
$AgNO_3$	n/100,000	6n/1,000,000 5n/10,000,000	5n/10,000,000	n/10,000,000
$NaNO_3$	?	5n/100 n/100	No acceleration.	n/1,000
Na_2SO_4	?	“	No acceleration.	“
$Sr(NO_3)_2$	?	5n/100	5n/1,000	n/1,000
$UO_2(NO_3)_2$	n/10,000	5n/100,000 n/100,000	n/100,000 5n/1,000,000	n/1,000,000
$Zn(NO_3)_2$	5n/10,000	n/10,000	5n/100,000	n/100,000
$ZnSO_4$	“	“	?	“

From the above statement of responses, it will readily be seen that the action of sulfate and nitrate is the same in practically all cases. This means, of course, that according to the dissociation hypothesis, the anions are comparatively without effect and that the responses just described are due to the presence of the metal ions in the medium. This is what should be expected from the fact that in the case of all the more poisonous salts the difference between experiment and control in concentration of the SO_4 or NO_3 ions is negligible. As has been said, these anions were chosen because they were already present in the nutrient medium. They are two out of the three which the plant uses most extensively in its metabolism, and thus it is not surprising that its protoplasmic system is of such a nature that slight, or even rather great, changes in their concentration are without visible effect upon the life-process. It will be remembered in this regard that it was shown in a previous paper * that a decrease to one-tenth its normal amount of any one of the nutrient salts used in Knop's solution is without effect upon this plant, so long as the osmotic properties of the solution are not altered by the change.

In order to study the question of the relation of stimulating power to the other properties of the metals studied, the following two lists were constructed. One is based on the lowest fatal concentrations, the other on the lowest concentration producing the palmella form. In the first column of each list is given the symbol of the cation (since anions play no part, they need not be considered), and in the second the concentration with regard to which the list is made. The elements are arranged in the order of their stimulating power, the weakest ones first. In cases where the least fatal concentration could not be determined with sharpness but where there are indications as to its position, slightly above or below the concentration given, the signs + and — are used to denote "greater than" and "less than." Where the sign is double it denotes "much greater than."

These lists are presented here in order to have the varying degrees of toxicity or stimulating power in mind before taking up the discussion of the three forms of response mentioned in a pre-

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* Livingston, B. E. On the nature of the stimulus which causes the change in form in polymorphic green algae. Bot. Gaz. 30: 289-317. 1900.

ceding paragraph. These three responses will now be considered under the three heads: (1) The response of death, (2) The response in phenomena of growth, and (3) The response in reproduction.

List of cations according to lowest fatal concentration.	
Element.	Concentration in Terms of *n*
Ca	5/100 ++
Mg	5/100 ++
K	5/100 ++
Na	5/100 ++
Sr	5/100 ++
Li	5/100 +
NH_4	1/100 +
Ba	1/100 +
Rb	1/100 —
Co	1/1,000
H	5/10,000
Zn	5/10,000 —
Fe	1/10,000
Ni	1/10,000
U	1/10,000
Al	1/10,000 —
Cd	1/10,000 —
Pb	1/10,000 —
Cu	1/100,000
Ag	1/100,000

List of cations according to the lowest concentration producing palmella form.	
Element.	Concentration in Terms of *n*
Ca	5/100
K	5/100
Sr	5/100
Mg	1/100
Na	1/100
Ba	1/1,000
Rb	1/1,000
NH_4	5/10,000
Li	5/10,000
Zn	1/10,000
H	6/100,000
Fe	5/100,000
Ni	5/100,000
Al	1/100,000
Cd	1/100,000
Co	1/100,000
U	1/100,000
Pb	5/1,000,000
Cu	5/10,000,000
Ag	5/10,000,000

III. DISCUSSION OF RESPONSES. 1. *The response of death.* — As has been stated, death must be considered as truly a response to stimuli as are any of the other alterations commonly passing under that name. Whatever may be the ultimate nature of the vital processes, they continue in such manner as to make up what is called life only while variation of the conditions external to the organism takes place within certain more or less narrow limits. Within these limits, changes of environment produce changes in the vital processes, and hence obvious changes in form, structure, and activity of the organism as a whole. Beyond them the necessary equilibrium of the many-sided system fails, and vitality ceases. Thus, the least concentration producing death may fairly be regarded as a criterion for estimating the stimulating power of any substance. The criterion for judging whether or not this plant is living is based on its loss of green color soon after death occurs.

No doubt all the salts tested here would produce death at *some* concentration, but those whose stimulating power or toxicity is weakest do not bring about this response until their concentration is high enough so that the osmotic pressure of the solution may begin to play its rôle. The cations Ca, Li, Mg, K, Na and Sr belong to this class, as do also probably NH_4, Ba, and perhaps Rb. The toxicity of these elements cannot be studied in a nutrient medium of as low pressure as the one here used. Perhaps it is impossible to determine it for the filamentous form of this plant.

What may be the nature of the killing power of the elements for which this property was determined is difficult to conjecture without more data. It is instructive to note, at any rate, that their effect in this regard is exactly similar to that of a drying medium. We see the same sort of death phenomena in these poisoned solutions of low osmotic pressure that was found for solutions of high pressure. In very strong solutions the cells die as filaments, in somewhat weaker ones they round off and assume the palmella form before death ensues. The relation of this toxicity to the physico-chemical nature of the elements will be considered in a later paragraph.

2. *The response in phenomena of growth.* — All of the elements tested produce the palmella response at some concentration. In case of Ca, K and Sr and perhaps of Mg and Na, this response may be in part due to osmotic pressure. For the other cations there can be no doubt that it is purely a chemical stimulus which is acting. The fact to be emphasized here again is that we have exactly the same growth changes brought about by the presence of toxic cations as are produced by physical extraction of water. In the poisoned cultures (whose osmotic pressure, it is to be remembered, is very low, much lower than is necessary for the retention of the filamentous form in an unpoisoned nutrient medium), there are observed exactly the same rounding up of cells, the same thickening of walls, and the same alteration in rapidity and direction of cell-division, as was found to take place when filaments are converted to the other form by the action of a concentrated solution.

These observations agree with those of the death responses, and it seems possible that in both cases we have to deal with a change in the water-content of the protoplasm. In the case of solutions of high osmotic pressure, water is extracted from the protoplasm directly, and it may be that this increasing density of the colloidal protoplasmic solution is accompanied by changes in its permeability to solute and in its general lability, and therefore chemical activity, which result in a higher osmotic pressure within the vacuole. I have been able to demonstrate this higher pressure by the plasmolytic method in cells of the palmella form. This higher osmotic pressure, as has been shown (*loc. cit.*, 1900), will suffice to explain the change in form of the cells and their partial or complete separation as they become spherical. A decrease in lability, and hence in general activity, may result in the observed thickening of the wall and in a change in the manner of cell-division, as is known to be the case in many plant and animal tissues under the influence of dryness and low temperature, where these are unquestionably concomitants of a decrease in the intensity of vital action.

But in case of toxic stimulation, with which this paper has to deal, there is no direct extraction or witholding of water from the cell, and by the principles of physics alone we are unable to see any difference between the poisoned and the unpoisoned nutrient medium. However, it is possible that the chemical stimulus of the toxic ions may be transformed, as the disturbance of the system passes within the limits of the protoplasm, and may become in this way a physical disturbance. It is well known that certain mineral salts hasten the coagulation of some proteids and other colloidal solutions,* and it is quite reasonable to suppose that the toxic ions upon entering the protoplasmic mass may produce in this vital hydrosol mixture an incipient coagulation or tendency toward the gel phase. If this were true it would mean that the colloidal particles become aggregated to some extent into denser masses, between and around which would lie a solution of less density, which would contain fewer colloidal particles than before. Thus, although by this supposed process of incipient coagulation water is not extracted from the protoplasmic solution as a whole, yet it is extracted from *certain parts* of this solution, namely from the partially coagulated groups or masses of colloidal particles. And if, as is probable, the seat of vital activity lies in the colloidal portion of the protoplasm rather than in the permeating aqueous solution, it becomes possible to see how an incipient production of the hydrogel phase in certain regions throughout the protoplasm may result in the same sort of alterations in permeability and lability as those brought about by general extraction of water with its accompanying increase in density of the vital substance. In brief, the suggestion here put forward is, that toxic ions may virtually bring about an extraction of water from the vital portions of the protoplasmic mass, and that this may result in the same obvious and tangible responses as those caused by direct extraction of water from the whole mass. Before this suggestion can be taken seriously it will be necessary to know more of the influence of ions upon colloidal solutions.

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* See Whetham, W. C. D. The coagulative power of electrolytes. Phil. Mag. V. 48 : 474–477. 1899.

Another possibility, closely related to the one just presented, is that the toxic cations may act upon the enzymes of the vital substance in such a manner as to bring about the changes noted. Indeed, the alteration of enzyme action (which appears in these days to have come to mean much the same as vital action, at least to play the leading part in our conception of the latter) may well be the common effect of water extraction and the entrance of poison cations into the living substance. Both suggestions are thus seen to be possible at the same time, the latter becoming a part of the former. The probability of the last idea, can be judged best only after more data have been obtained on the effect of poisons upon enzyme action, which work has happily already begun. *

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* See the following papers on this subject:

Zoethout, W. D. On the production of contact irritability without the precipitation of Ca salts. Am. Jour. Physiol. 10: 324–334. 1904.— Further experiments on the influence of various electrolytes upon the tone of skeletal muscles. Am. Jour. Physiol. 10: 373–377. 1904.

Brown, O. H. Effects of certain salts on kidney excretion with especial reference to glycosuria. Am. Jour. Physiol. 10: 378–383. 1904.

Neilson, C. H. & Brown, O. H. Effect of ions on decomposition of hydrogen peroxide and hydrolysis of butyric ether by watery extracts of pancreas. Am. Jour. Physiol. 10: 335–344. 1904.—Effects of ions on decomposition of hydrogen peroxide by platinum black. Am. Jour. Physiol. 10: 225–228. 1904.

Neilson, C. H. The hydrolysis and synthesis of fats by platinum black. Am. Jour. Physiol. 10: 191–200. 1903.

McGuigan, H. Relation between decomposition tension of salts and their antifermentative properties. Am. Jour. Physiol. 10: 444–451. 1904.

3. The response in phenomena of reproduction. — With most of the cations studied there is a curious difference between the effect of drying solutions (of high pressure) and poisoned ones. This lies in the observed fact that in the latter zoöspore production may not only be as active as in the unpoisoned control, but that it may be much more active, while in the former zoöspore production is entirely inhibited. Thus extraction of water produces the palmella form and inhibits zoöspores, while the presence of toxic cations produces the palmella form, but also, at some concentration, generally accelerates the production of zoöspores. This would seem to prove that the relation between the two sets of responses is not as simple as might otherwise be supposed. It seems possible that the production of zoöspores is due to a somewhat different set of changes in the protoplasm from those involved in ordinary growth, a set of changes which may be started by several apparently different external factors. The phenomena of reproduction lie at present so much within the province of the unknown that it would probably be unprofitable to attempt any hypothesis in this regard. Attention may be called here, however, to the fact that there are fairly well-known activities taking place simultaneously within plant protoplasm, and yet controlled by entirely different sets of factors. As examples may be mentioned the processes of photosynthesis and respiration.

The fact that the acceleration here held in view is not observed in case of the cations, K, Rb, and Na, and is somewhat questionable in that of Li and Mg, together with the fact that these elements are among the least toxic, seems to show that there is some sort of a relation between the responses of death and change in growth, on the one hand, and of reproduction on the other. This matter of stimulation of reproductive activity may be a fertile field for further investigation.

Lillie, R. S. Relation of ions to ciliary movement. Am. Jour. Physiol. 10 : 419–443. 1904.

Mathews, A. P. The nature of chemical and electrical stimulation. I. The physiological action of ions depends on electrical state and electrical stability. Am. Jour. Physiol. 11 : 445–496. 1904.

Cole, S. W. Contributions to our knowledge of enzyme action. I. Influence of electrolytes on action of amylolytic ferments. Jour. Physiol. 30 : 202–220. 1903. — Contributions to our knowledge of enzyme action. II. Influence of electrolytes on the action of invertin. Jour. Physiol. 30 : 281–289. 1903.

LITERATURE

In any consideration of the general relation of the properties of reagents to those of responding organisms, it is essential to have a considerable mass of data from different forms of the latter. It is also desirable, of course, to know the relative stimulating or toxic power of as many elements as possible upon the same organism. The literature contains a respectable number of titles dealing with the question before us, but unfortunately the majority of the determinations have been made in such a manner as to render them quite inadequate for the present purpose. The work that has been done on plants has been briefly summarized, up to the time of his publication, by Copeland,[*] and a more recent review of certain phases of the subject comes from the hand of Benecke.[†] Observations which have an immediate relation to the results here presented will be stated briefly in the following paragraphs.

Acceleration of growth in *Aspergillus* and *Penicillium* was studied by Richards,[‡] and in part corroborated by Miss Watterson.[§] For the former of these fungi $ZnSO_4$ accelerates growth most at concentrations of 0.002 per cent. ($6n/100,000$) to 0.004 per cent. ($12n/100,000$). The salt is harmful at concentrations from 0.05 per cent. ($16n/10,000$) to 0.075 per cent. ($24n/1,000$). $FeSO_4$ accelerates growth a little at 0.2 per cent. ($26n/1,000$), and the culture is normal at 0.033 per cent. ($44n/10,000$). $CoSO_4$ accelerates both fungi most at 0.002 per cent. ($26n/100,000$), while $NiSO_4$ shows the same response at 0.003 per cent. ($85n/100,000$). I have translated the percentage figures approximately into terms of a normal solution, and placed them in the parenthesis which follows each figure.

Ono[||] worked with both algae and fungi. His results may be tabulated as follows. Underneath his molecular concentrations I have placed the equivalent strength in terms of normal.

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[*] Copeland, E. B. Chemical stimulation and the evolution of carbon dioxid. Bot. Gaz. **35**: 81–98, 160–183. 1903.

[†] Benecke, W. Einige neuere Untersuchungen über den Einfluss von Mineralsalzen auf Organismen. Bot. Zeitung **62**^{2}: 113–126. 1904.

[‡] Richards, H. M. Die Beeinflussung des Wachsthums einiger Pilze durch chemische Reize. Jahrb. Wiss. Bot. **30**: 665–679. 1897.

[§] Watterson, A. The effect of chemical irritation on the respiration of fungi. Bull. Torrey Club **31**: 291–303. 1904.

[||] Ono, N. Ueber die Wachsthumsbeschleunigung einiger Algen und Pilze durch chemische Reize. Jour. Coll. Sci. Imp. Univ. Tokyo **13**: 141–186. 1900. Also Bot. Mag. Tokyo, **14**: 75. 1900.

Table of results obtained by Ono

Subject.	Salt.	Concentration for acceleration of vegetative growth.	Injurious concentration.	Normal growth.
Protococcus.	$ZnSO_4$	$\frac{1}{2}\ 10^{-6}m - 10^{-5}m$ $25n/100{,}000{,}000 - 5n/1{,}000{,}000$	$\frac{1}{2}\ 10^{-4}m$ $25n/1{,}000{,}000$	
	$CoSO_4$	$\frac{1}{25}\ 10^{-5}m - 10^{-5}m$ $2n/1{,}000{,}000 - 5n/1{,}000{,}000$	$\frac{1}{2}\ 10^{-4}m$ $25n/1{,}000{,}000$	
	$HgCl_2$	No acceleration.	$\frac{1}{25}\ 10^{-5}m$ $2n/10{,}000{,}000$	
	NaF	$\frac{1}{125}\ 10^{-3}m - \frac{1}{5}\ 10^{-3}m$ $8n/1{,}000{,}000 - 4n/10{,}000$	$10^{-3}m$ $n/1{,}000$	
	$LiNO_3$	$\frac{1}{25}\ 10^{-4}m - 10^{-4}m$ $4n/1{,}000{,}000 - n/10{,}000$	$\frac{1}{2}\ 10^{-3}m$ $5n/10{,}000$	
	K_3AsO_4	$\frac{1}{125}\ 10^{-4}m - \frac{1}{25}\ 10^{-4}m$ $26n/100{,}000{,}000 - 13n/10{,}000{,}000$	$10^{-4}m$ $33n/1{,}000{,}000$	$\frac{1}{5}\ 10^{-4}m$ $66n/10{,}000{,}000$
Chroococcum.	$ZnSO_4$	$\frac{1}{25}\ 10^{-5}m - 10^{-5}m$ $2n/10{,}000{,}000 - 5n/1{,}000{,}000$		$\frac{1}{2}\ 10^{-4}m$ $25n/1{,}000{,}000$
	$CuSO_4$	No acceleration.	$\frac{1}{5}\ 10^{-5}m$ $n/1{,}000{,}000$	$\frac{1}{25}\ 10^{-5}m$ $2n/10{,}000{,}000$
Hormidium.	$FeSO_4$	$\frac{1}{25}\ 10^{-4}m - \frac{1}{2}\ 10^{-3}m$ $2n/1{,}000{,}000 - 25n/100{,}000$		
	$NiSO_4$	$\frac{1}{25}\ 10^{-5}m - \frac{1}{5}\ 10^{-4}m$ $2n/10{,}000{,}000 - n/100{,}000$	$\frac{1}{2}\ 10^{-4}m$ $25n/1{,}000{,}000$	$10^{-5}m$ $5n/1{,}000{,}000$
	$CoSO_4$	$\frac{1}{25}\ 10^{-5}m$ $2n/10{,}000{,}000$	$\frac{1}{5}\ 10^{-5}m$ $n/1{,}000{,}000$	$\frac{1}{2}\ 10^{-4}m$ $25n/1{,}000{,}000$
Stigeoclonium.	$CuSO_4$	No acceleration.	$\frac{1}{5}\ 10^{-5}m -$ $\frac{1}{25}\ 10^{-5}m$ $n/1{,}000{,}000 -$ $2n/10{,}000{,}000$	
Aspergillus.	$ZnSO_4$	$\frac{1}{8}\ 10^{-3}m - 10^{-3}m$ $6n/100{,}000 - 5n/10{,}000$		
	$NiSO_4$	$\frac{1}{8}\ 10^{-3}m - 10^{-3}m$ $6n/100{,}000 - 5n/10{,}000$		
	$CoSO_4$	$\frac{1}{16}\ 10^{-3}m - \frac{1}{2}\ 10^{-3}m$ $3n/100{,}000 - 25n/100{,}000$		
	$CuSO_4$	$\frac{1}{16}\ 10^{-3}m - \frac{1}{2}\ 10^{-3}m$ $3n/100{,}000 - 25n/100{,}000$		
	$HgCl_2$	$\frac{1}{8}\ 10^{-4}m - \frac{1}{16}\ 10^{-3}m$ $6n/1{,}000{,}000 - 3n/100{,}000$	$\frac{1}{8}\ 10^{-3}m$ $3n/100{,}000$	
	$LiNO_3$	$\frac{1}{16}\ 10^{-2}m - \frac{1}{2}\ 10^{-2}m$ $6n/10{,}000 - 5n/100$		
	NaF	$\frac{1}{16}\ 10^{-2}m - \frac{1}{8}\ 10^{-2}m$ $6n/10{,}000 - 125n/100{,}000$	$\frac{1}{2}\ 10^{-2}m$ $5n/100$	$\frac{1}{4}\ 10^{-2}m$ $25n/10{,}000$
Penicillium.	$FeSO_4$	$\frac{1}{4}\ 10^{-3}m - \frac{1}{2}\ 10^{-3}m$ $125n/1{,}000{,}000 - 25n/100{,}000$	$2 \times 10^{-3}m$ $n/1{,}000$	$10^{-3}m$ $5n/100$
	$CoSO_4$	$\frac{1}{16}\ 10^{-3}m - \frac{1}{2}\ 10^{-3}m$ $3n/100{,}000 - 25n/100{,}000$		
	$HgCl_2$	$\frac{1}{16}\ 10^{-3}m - \frac{1}{2}\ 10^{-3}m$ $3n/100{,}000 - 25n/100{,}000$		

This author observed no acceleration in reproductive activity. The accelerations which he noted, — and they occurred for algae with all salts excepting $AgCl_2$ and $CuSO_4$, and with all salts tried for fungi,— always consisted in a hastening of the growth rate, thus giving weight of yield greater than that of the control. His form of *Stigeoclonium* was different from mine. Nothing is said about its being polymorphic, while with my form the important responses are all those which are bound up in the physiology of polymorphism. This difference in the response of acceleration would seem to indicate that even the most nearly related organisms may react differently towards the same stimuli. The concentration limits were not determined sharply enough to make any rigid comparison of these profitable. As far as comparison can be made the results of my experiments seem to agree in a general way with those obtained by Ono.

Richter * was unable to get an acceleration of growth in *Aspergillus* with Cu although he obtained this response with Zn. It may be that in these lower forms there are great physiological variations within a single species. This would account for some of the apparent discrepancy in regard to the effects of these salts which have been tried so often. For a description of the behavior of a form of *Penicillium* peculiarly resistant to copper and one extraordinarily resistant to arsenic, see the work of De Seynes † and Gosio.‡

Stevens § tested the influence of a number of salts in inhibiting the germination of spores of several fungi. The following table compiled from one of his, gives the lowest inhibiting concentrations for the forms there named, with respect to those salts which he and I have both tested. I have corrected his terminology from *n* to *m*, and have added underneath his figures the approximately equivalent concentration in the normal and decimal system. The sign > preceding a concentration denotes that the limit as stated is somewhat too low.

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* Richter, A. Zur Frage der chemischen Reizmittel. Centralbl. für Bacteriol. 7 : 417–429. 1901.

† De Seynes, J. Resultats de la culture du *Penicillium cupricum* Trabut. Bull. Soc. Bot. France 42 : 451–455, 482–485. 1895.

‡ Gosio, B. Zur Frage wodurch die Giftigkeit arsenhaltiger Tapeten bedingt wird. Ber. Deutsch. Chem. Ges. 30 : 1024–1026. 1897.

§ Stevens, F. L. The effect of aqueous solutions upon the germination of fungus spores. Bot. Gaz. 26 : 377–406. 1898.

TABLE OF CERTAIN RESULTS OBTAINED BY STEVENS: LOWEST INHIBITING CONCENTRATION

Salt.	*Botrytis.*	*Macrosporium.*	*Gloeosporium.*	*Penicillium.*	*Uromyces.*
HCl	....	$>m/50$ $>2n/100$	$>m/100$ $>n/100$	$>m/50$ $>2n/100$	$m/50$ $2n/100$
H_2SO_4	....	$>m/50$ $>n/100$	$>m/100$ $>5n/1,000$	$>m/50$ $>n/100$	$m/50$ $>n/100$
$CuSO_4$	$m/3,200$ $15n/10,000$	$m/6,400$ $75n/100,000$	....	$m/200$ $25n/10,000$	$m/3,200$ $15n/10,000$
$Cu(NO_3)_2$	$m/3,200$ $15n/10,000$	$>m/3,200$ $>15n/10,000$	....	$m/200$ $25n/10,000$	$m/3,200$ $15n/10,000$
NH_4NO_3	$m/2$ $5n/10$	....	....	$m/2$ $5n/10$	$m/2$ $5n/10$
$MgSO_4$	....	....	....	$>m/10$ $>5n/100$	....

Clark * worked in a field similar to that of Stevens, making valuable determinations of the effect of poisons upon fungus growth as well as upon the germination of spores. Below are presented those of his results which are of most interest in the present connection. The figures denote the lowest fatal strength for the organisms indicated. I have added the decimal equivalent as above, placing it to the right of the sign =, and have arranged the salts in the order of their toxicity.

TABLE OF CERTAIN RESULTS OBTAINED BY CLARK

Aspergillus.		*Sterigmatocystis.*	
Salt.	Fatal concentration.	Salt.	Fatal concentration.
$CoSO_4$	$n = n$	$CoSO_4$	$n = n$
HCl	$n/4 = 25n/100$	$ZnSO_4$	$n = n$
$CuSO_4$	$n/4 = 25n/100$	HCl	$n/2 = 5n/10$
$Cu(NO_3)_2$	$n/4 = 25n/100$	HNO_3	$n/4 = 25n/100$
H_2SO_4	$n/8 = 125n/1,000$	$Ni(NO_3)_2$	$n/4 = 25n/100$
HNO_3	$n/16 = 625n/10,000$	$Cu(NO_3)_2$	$n/4 = 25n/100$
$Cd(NO_3)_2$	$n/64 = 156n/10,000$	$CuSO_4$	$n/8 = 125n/1,000$
$AgNO_3$	$n/2,048 = 49n/100,000$	H_2SO_4	$n/16 = 625n/10,000$
		$Cd(NO_3)_2$	$n/32 = 313n/10,000$
		$AgNO_3$	$3n/4,096 = 245/1,000,000$

Penicillium.		*Penicillium.*	
Salt.	Fatal concentration.	Salt.	Fatal concentration.
$CoSO_4$	$n = n$	H_2SO_4	$n/2 = 5n/10$
$CuSO_4$	$n = n$	$Ni(NO_3)_2$	$n/2 = 5n/10$
$Cu(NO_3)_2$	$n = n$	HNO_3	$n/4 = 25n/100$
$ZnSO_4$	$n = n$	$Cd(NO_3)_2$	$n/256 = 39n/10\ 000$
HCl	$n/2 = 5n/10$	$AgNO_3$	$n/32,768 = 305n/10,000,000$

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* Clark, J. F. On the toxic effect of deleterious agents on the germination and development of certain filamentous fungi. Bot. Gaz. **28**: 289–327, 378–404. 1899. — Electrolytic dissociation and toxic effect. Jour. Phys. Chem. **3**: 263–316. 1899.

Oedocephalum.		*Botrytis.*	
Salt.	Fatal concentration.	Salt.	Fatal concentration.
$CoSO_4$	$2n = 2n$	$ZnSO_4$	$n = n$
$ZnSO_4$	$n/2 = 5n/10$	$CoSO_4$	$n/4 = 25n/100$
HCl	$n/8 = 125n/1{,}000$	HCl	$n/8 = 125n/1{,}000$
HNO_3	$n/8 = 125n/1{,}000$	HNO_3	$n/16 = 625n/10{,}000$
H_2SO_4	$n/16 = 625n/10{,}000$	$CuSO_4$	$n/32 = 313n/10{,}000$
$Ni(NO_3)_2$	$n/16 = 625n/10{,}000$	$Cu(NO_3)_2$	$n/32 = 313n/10{,}000$
$CuSO_4$	$n/64 = 156n/10{,}000$	H_2SO_4	$n/64 = 156n/10{,}000$
$Cu(NO_3)_2$	$n/64 = 156n/10{,}000$	$Ni(NO_3)_2$	$n/128 = 78n/10{,}000$
$Cd(NO_3)_2$	$n/128 = 78n/10{,}000$	$Cd(NO_3)_2$	$n/4{,}096 = 245n/1{,}000{,}000$
$AgNO_3$	$n/32{,}768 = 305n/10{,}000{,}000$	$AgNO_3$	$n/8{,}192 = 123n/1{,}000{,}000$

The results of these studies of the relative toxicity of the metals toward algae and fungi are presented below in the form of lists, so that they may be more readily compared. The salts studied are arranged in order of their stimulating effect — beginning with the least effective — under the name of the subject. A vertical line at the left of several salts denotes their apparent equality in the series. Superscript letters attached to the subject names denote authors, as follows: (*a*) Richards; (*b*) Ono; (*c*) Livingston; (*d*) Clark; and (*e*) Stevens.

STIMULATION.

Aspergillus[a].	*Aspergillus*[b].	*Penicillium*[b].	*Protococcus*[b].	*Stigeoclonium*.[c]
$FeSO_4$	$HgCl_2$	$FeSO_4$	$ZnSO_4$	Ca
$NiSO_4$	$CuSO_4$	$CoSO_4$	$CoSO_4$	K
$CoSO_4$	$CoSO_4$	$HgCl_2$	$LiNO_3$	Sr
$ZnSO_4$	$NiSO_4$			Mg
	$ZnSO_4$			Na
	$LiNO_3$			Ba
				Rb
				NH_4
				Li
				Zn
				H
				Fe
				Ni
				Al
				Cd
				Co
				U
				Pb
				Cu
				Ag

FATAL STRENGTH

Aspergillus[d].	*Penicillium*[e].	*Penicillium*[d].	*Protococcus*[h].	*Botrytis*[e].	*Botrytis*[d].
$CoSO_4$	NH_4NO_3	$CoSO_4$	$HgCl_2$	NH_4NO_3	$ZnSO_4$
HCl	$MgSO_4$	$CuSO_4$	$ZnSO_4$	$CuSO_4$	$CoSO_4$
$CuSO_4$	HCl	$Cu(NO_3)_2$	$CoSO_4$	$Cu(NO_3)_2$	HCl
$CuNO_3$	H_2SO_4	$ZnSO_4$	$LiNO_3$		HNO_3
H_2SO_4	$CuSO_4$	HCl			$CuSO_4$
HNO_3	$Cu(NO_3)_2$	H_2SO_4			$CuNO_3$
$Cd(NO_3)_2$		$Ni(NO_3)_2$			H_2SO_4
$AgNO_3$		HNO_3			$Ni(NO_3)_2$
		$Cd(NO_3)_2$			$Cd(NO_3)_2$
		$AgNO_3$			$AgNO_3$

Macrosporium[e].	*Uromyces*[e].	*Sterigmatocystis*[d].	*Oedocephalum*[d].	*Stigeoclonium*[e].
HCl	NH_4NO_3	$CoSO_4$	$CoSO_4$	Ca
H_2SO_4	HCl	$ZnSO_4$	$ZnSO_4$	Mg
$Cu(NO_3)_2$	H_2SO_4	HCl	HCl	K
$CuSO_4$	$CuSO_4$	HNO_3	HNO_3	Na
	$Cu(NO_3)_2$	$Ni(NO_3)_2$	H_2SO_4	Sr
		$Cu(NO_3)_2$	$Ni(NO_3)_2$	Li
		$CuSO_4$	$CuSO_4$	NH_4
		H_2SO_4	$Cu(NO_3)_2$	Ba
		$Cd(NO_3)_2$	$Cd(NO_3)_2$	Rb
		$AgNO_3$	$AgNO_3$	Co
				H
				Zn
				Fe
				Ni
				U
				Al
				Cd
				Pb
				Cu
				Ag

A comparison of the above lists will make it clear at once that there is only a very general agreement between them. In the present state of our knowledge nothing more need be said.

The literature of the effect of toxic substances on higher plants, although more extensive, is in a more unsatisfactory state than that concerning the lower ones. It would be somewhat out of the field of the present paper to go here into detail as to the concentrations which accelerate growth and those which kill higher plants. It is well established that most of the metals, when at the right strength, do accelerate growth of seedling roots, but there is discrepancy among the several observers as to the limits. The same is true of fatal doses. Kahlenberg and True * and Heald* worked upon *Lupinus*, *Pisum* and *Zea* radicles, finding an acceleration in case of the cations H, Cu, Ni, Co and Ag. Kahlenberg and Austin† determined the concentration of ionic H which can be borne by seedlings of *Lupinus* when their roots are in solutions of acid sodium salts. Coupin‡ made determinations of the effect of solutions of salts of Na, K, and NH_4 upon wheat seedlings. Kanda§ worked with *Pisum* and *Vicia* seedlings and with $CuSO_4$ and $ZnSO_4$. Studies on the toxicity of a number of acids and their Ca and K salts upon wheat, clover, and maize, were made by Cameron and Breazeale.|| True and Gies¶ have recently carried out what is probably now the most satisfactory research we have on this subject. They determined for *Lupinus* the stimulating strengths and fatal concentrations for the salts of Cu, Ag, Hg, Zn, Na, K, Ca and Mg. F. A. Loew** worked upon the effect of H and OH ions on *Zea* seedlings, and Dandeno†† has just published a paper on experiments in this line with seedlings of *Zea*, *Lupinus*, and *Pisum*. The latter author made determinations of the neutralizing power of seedling roots in toxic solutions, which appears to be a very important consideration and one which seems not to have been attacked before. This author demonstrates also, what had already been described by True and Oglevee‡‡ that the presence of insoluble bodies has an influence upon the physiological effect of salt solutions. This is the phe-

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* Kahlenberg, L. & True, R. H. On the toxic action of dissolved salts and their electrolytic dissociation. Bot. Gaz. **22**: 81–124. 1896.

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*Heald, F. de F. On the toxic effect of dilute solutions of acids and salts upon plants. Bot. Gaz. **22**: 125–153. 1896.

†Kahlenberg, L. & Austin, R. W. The action of acid sodium salts on *Lupinus albus*. Jour. Phys. Chem. **4**: 553–569. 1900.

‡Coupin, H. Sur la toxicité des composés du sodium, du potassium, et de l'ammonium à l'égard des végétaux supérieurs. Rev. Gén. Bot. **12**: 177–194. 1900.

§Kanda, M. Studien über die Reizwirkung einiger Metallsalze auf das Wachsthum höherer Pflanzen. Jour. Coll. Sci. Imp. Univ. Tokyo 19^{13}: 1–37. 1904.

||Cameron, F. K. & Breazeale, J. F. The toxic action of acids and salts on seedlings. Jour. Phys. Chem. **8**: 1–13. 1904.

¶True, R. H. & Gies, W. J. On the physiological action of some of the heavy metals in mixed solutions. Bull. Torrey Club **30**: 390–402. 1903.

Loew, F. A. The toxic effect of H and OH ions on seedlings of Indian corn. Science II. **18: 304–308. 1903.

††Dandeno, J. B. The relation of mass action and physical affinity to toxicity. Am. Jour. Sci. IV. **17**: 437–458. 1904.

‡‡True, R. H. & Oglevee, C. S. The effect of the presence of insoluble substances on the toxic action of poisons. Science II. **19**: 421–424. 1904. — Also Bot. Gaz. **39**: 1–21. 1905.

nomenon of adsorption known to soil physicists for some time,* but only now applied to the study of toxicity of salts. It appears from Dandeno's paper that even the walls of the vessel in which a water culture is grown may exert an appreciable influence in this way, thus decreasing the stimulating power of a solution.

It is well to call attention here also to three papers in the same field in animal physiology. The influence of poison salts upon fishes was studied by Kahlenberg and Mehl † and determination made of the killing concentrations. As their results show, these authors were working largely with the toxic effect of the solutions upon the delicate vascular membranes of the gills. Kahlenberg ‡ also made a study of the relation of taste to acidity, in salts and acids. But by far the best and most satisfactory paper which has appeared from the animal side, and in many ways from the standpoint of all general physiology, is that of Mathews § who carefully determined for a large number of salts, the concentrations necessary to inhibit the development of eggs of the fish, *Fundulus heteroclitus*. His paper will be discussed to some degree a little farther on.

The effect of one salt or ion in counteracting that of another, when these are in a mixed solution is a very important topic in connection with the general subject of stimulation, Krönig and Paul,|| Clark,¶ Kearney and Cameron,** True,†† and True and Gies,§§ and others have investigated this question with interesting result which cannot be even touched upon here.

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* See Briggs, L. J. The mechanics of soil moisture. U. S. Dept. Agric. Div. of Soils, Bull. No. 10. 1897. — Investigations on the properties of soils. U. S. Dept. Agric. Field Operations Div. Soils, 1900: 415–421. 1901.

† Kahlenberg, L. & Mehl, H. F. Toxic action of electrolytes upon fishes. Jour. Phys. Chem. 5: 113–132. 1901.

‡ Kahlenberg, L. The relation of the taste of acid salts to their degree of dissociation. Jour. Phys. Chem. 4: 533–537. 1900.

§ Mathews, A. P. The relation between solution tension, atomic volume, and the physiological action of the elements. Am. Jour. Physiol. 10: 290–323. 1904. — See also his previous paper on nerve irritability, Science II. 17: 728–733. 1903.

|| Krönig, B. & Paul, T. Zeitschr. für Hygiene u. Infect. 25: 1–112. 1897.

¶ Clark, J. F. Jour. Phys. Chem. 5: 289–316. 1901.

** Kearney, T. H. and Cameron, F. K. U. S. Dept. Agric. Report No. 71. 1902.

†† True, R. H. Am. Jour. Sci. IV. 9: 183–192. 1900.

§§ True, R. H. & Gies, W. J. Bull. Torrey Club 30: 390–402. 1903.

NATURE OF TOXICITY

Although a number of attempts have been made to find out what it is in the nature of these toxic substances which gives them their stimulating power, there has been practically no outcome of it all until the appearance of Mathew's paper above referred to. Practically all of the toxicity series which have been made out seem to agree in certain respects, *e. g.*, they do not follow the valence of the elements involved, nor do they follow the order of atomic weights; on the other hand, it is usually evident that, in some sort of a general way, they do depend upon the chemical nature of these elements, the more inert atoms always appearing as of low stimulating power while Cu, Ag, Pt, etc., lie at the opposite end of the series. This much is as evident from my work as it is from that of Kahlenberg and True, Clark and Mathews.

The last-named author has discovered a remarkable similarity between his toxicity series and three chemical series formed on the basis, respectively, of *solution tension*, *atomic volume*, and a *function obtained by dividing the equivalent weight by the atomic volume.* With none of these series my results agree accurately, but a comparison of his published tables with those here presented (page 20) will show some remarkable points of resemblance. It would appear from a comparison of all the work available on this subject that, while the suggestion of the author just named seems to fall short of explaining the relation of toxicity in general to chemical properties, yet he has at least given us the only rational basis for exploration of this difficult field.

That different organisms behave differently in the same solution is to be expected from the mere fact that they *are* different organisms, *i. e.*, that their protoplasms are not identical. The points of similarity in different protoplasms have become so strongly emphasized (as is illustrated by the fact that we use the single term protoplasm to include them all), that their essential points of difference have often been partially lost sight of. The toxicity series for any form is doubtless conditioned by a complex function derived, on the one hand, from the properties of its protoplasm as an organic mixture and a colloidal solution, and, on the other from some such properties of the elements as those considered by Mathews.

It would be unnecessarily increasing the bulk of literature to attempt a discussion of the discrepancies between the different series at hand. It is almost certain that the present lively activity of physiologists in this regard will soon unearth additions to our knowledge of the facts which will be vastly more valuable than any amount of the older-fashioned *a priori* discussion of all the conceivable possibilities of the case. The writer hopes in the near future to study in a similar manner the influence of anions and of certain organic poisons upon this organism.

SUMMARY

The important results here described may be briefly stated as follows:

1. Nitrate and sulfate, in the case of a large number of metallic elements, act in the same way and at the same concentration upon the filamentous form of this alga. According to the theory of dissociation, we conclude that the stimulation is due to the cations.

2. At high enough concentrations death is produced.

3. At somewhat lower concentrations most of the cations produce a change in form of the cells and in the manner of cell division, which is strictly parallel to the change brought about by extraction of water or inhibition of its absorption.

4. Often at the same concentration as that mentioned in (3), and in most cases at a strength somewhat lower than this, there is a marked acceleration in the production of zoöspores. This is exactly the opposite of what results from water-extraction.

5. The acceleration in zoöspore activity gradually decreases with weaker solutions of the poison until the normal behavior of the filamentous form is reached.

6. In general, the relative degrees of toxicity of the metals here studied follow the order of those studied by other workers with different organisms. But there are many unexplained discrepancies.

THE DESERT BOTANICAL LABORATORY OF THE
CARNEGIE INSTITUTION, TUCSON, ARIZONA, Aug. 5, 1904.

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The Occurrence and Origin of Amber in the Eastern United States

By ARTHUR HOLLICK

NEW YORK
1905

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THE OCCURRENCE AND ORIGIN OF AMBER IN THE EASTERN UNITED STATES.[1]

ARTHUR HOLLICK.

A Recent Discovery of Amber in the Cretaceous Deposits at Kreischerville, N. Y.

Preliminary Note.— A recent discovery of amber in considerable quantity, in connection with the Cretaceous deposits at Kreischerville, Staten Island, N. Y., may be found briefly recorded by the writer in the *Proceedings* of the Natural Science Association of Staten Island for November 12th, 1904, but without any extended description or discussion. The discovery, however, was found to have aroused an unexpected interest in the subject, and the preparation of this paper was suggested.

Geologic Age and General Description of the Deposits.—The deposits in question consist of clays and sands which represent a part of the eastward extension of the Amboy clay series of New Jersey and are included in the Raritan formation, which is generally recognized as middle Cretaceous in age and approximately the equivalent of the Cenomanian of Europe, the lower Atane beds of Greenland, and the Dakota group of the West.

At Kreischerville they have been extensively excavated for economic purposes and in what is known as the Androvette pit a section was recently exposed, consisting of irregularly bedded clays and sands, referable to the geologic horizon above mentioned, overlain unconformably by more recent sands and gravels, the entire series showing more or less disturbance by glacial action. A view of a portion of the pit is shown in Plate 1.

Conditions Under Which the Amber Occurs.— The amber occurs in a stratum or bed, characterized by layers and closely packed masses of vegetable débris, consisting of leaves, twigs,

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[1] Read before the Botanical Society of America, Philadelphia meeting, Dec. 30, 1904. Investigations prosecuted with the aid of a grant from the Society.

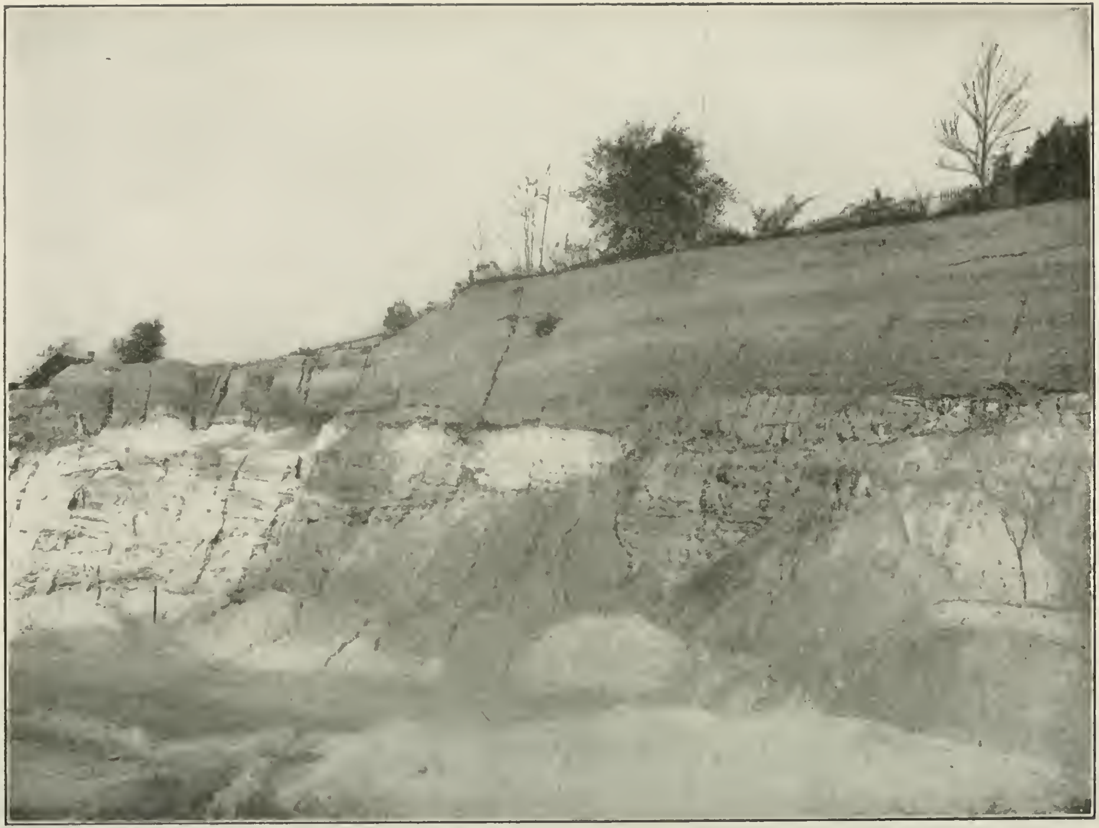

Plate 1.—Section in Androvette pit, Kreischerville, Staten Island, N. Y., showing unconformity between Cretaceous clays and sands below and Tertiary or Pleistocene sands and gravels above.

and fragments of lignite and charred wood. Pyrite, in nodules, is also a prominent constituent. This bed, where exposed in vertical section, appears as if lens-shaped, having an indicated maximum thickness of about 3 feet and a lateral extent of 18 feet or more. The face of the pit at this place is about 20 feet high and the lower part of the bed is about 1 foot from the present floor of the pit. The section in which the bed is exposed is shown in Plate 2. It is immediately adjacent to the left of the section shown in Plate 1.

Most of the amber was found in a relatively thick accumulation of finely comminuted lignite and charred wood, of limited extent, through which it was irregularly distributed. This matrix yielded nearly all of the larger specimens and a majority of the smaller ones. The remainder were obtained from the relatively thinner layers of leaves and twigs. A piece of the lignitic matrix, with fragments of amber enclosed, is shown on Plate 3, Fig. 34.

Characters of the Amber.— A large part of the amber is in the form of drops or "tears," examples of which may be seen on Plate 3, Figs. 1–23, but irregularly shaped fragments, varying in size from a large pin's head to a hickory nut, are the most abundant. They are generally more or less transparent and yellow or reddish in color, but many are opaque and grayish white. Some of the best examples of the former are shown on Plate 3, Figs. 24–32, and a large piece of the latter on Plate 3, Fig. 33. The finest specimen in size, color, and transparency, represented by Fig. 32, is about 6 cu. cm. in volume. All of the figures on Plate 3 are of natural size.

Disposition of the Specimens.— Most of the specimens collected are deposited in the museum of the New York Botanical Garden and the remainder in that of the Natural Science Association of Staten Island. The only other specimens from this vicinity which I have been able to locate are included in the collections at Columbia University. These are three in number and are labeled respectively, "Marl pits, Squankum, N. J.," "Kirby's marl pit, Harrisonville, N. J.," and "Valentine's clay pit, Woodbridge, N. J." The last mentioned is of good quality and is about the size of a filbert nut.

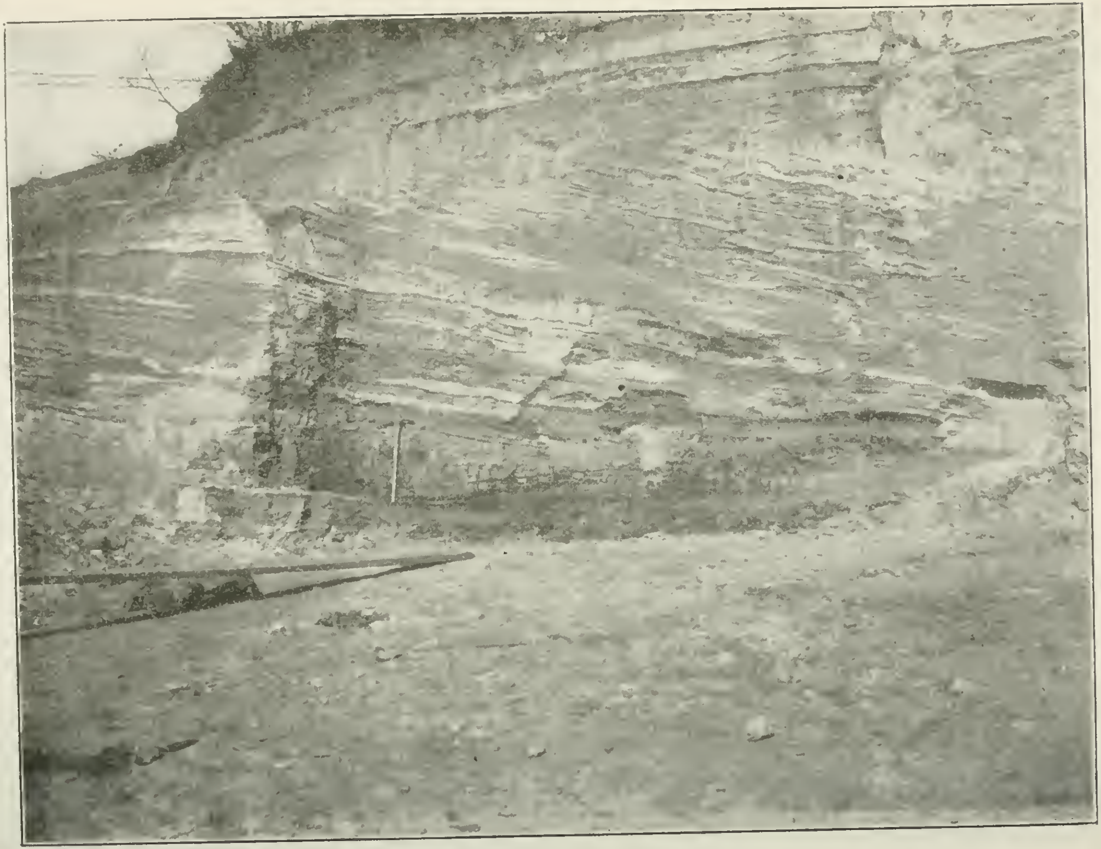

PLATE 2.—Section in Androvette pit, Kreischerville, Staten Island, N. Y., at extreme left of Plate 1, showing stratification of the Cretaceous deposits and bed, indicated by the pick, in which leaves and amber occur.

PREVIOUS RECORDS OF THE OCCURRENCE OF AMBER IN THE EASTERN UNITED STATES.

It is probable that amber is far more common in the Cretaceous deposits of the eastern United States than is generally supposed. The amount that may be obtained at the Kreischerville locality alone is considerable, as evidenced by the relatively large quantity that was obtained in the few hours devoted to the work, from the small portion of the exposure examined; and reports of its occurrence elsewhere indicate that careful search, with amber as the object in view, would produce excellent results.

Probably the earliest published record on the subject is contained in an article by G. Troost, entitled: "Description of a Variety of Amber and of a Fossil Substance supposed to be the Nest of an Insect, discovered at Cape Sable, Magothy River, Anne Arundel County, Maryland" (*Am. Journ. Sci.*, vol. 3, 1821, pp. 8-15), in which he describes the amber as occurring with lignite, and says (p. 9): "This lignite seems to be formed of three varieties of wood, or rather the wood has undergone three different changes, some pieces of which are entirely charred, often changed into bituminous wood, and others again having undergone very little change from the brown lignite. All these varieties, particularly the brown lignite and the charred wood, are penetrated by pyrites, and are sometimes entirely changed into it."

The above account is of considerable interest to us for the reason that the geologic horizon in which the amber was found at Cape Sable is approximately the equivalent of that at Kreischerville, and the conditions under which it occurs at both places are evidently identical. The meaning or significance of the charred wood presents an interesting problem, as it apparently indicates the direct effect of fire, at or immediately prior to the time when the deposits were laid down, and not that of any chemical change such as resulted in the gradual transformation of the wood into lignite. Further than this, its occurrence in such widely separated localities indicates that whatever the source of the heat may have been, the effects were far-reaching and extended over a considerable area. The same author, in the

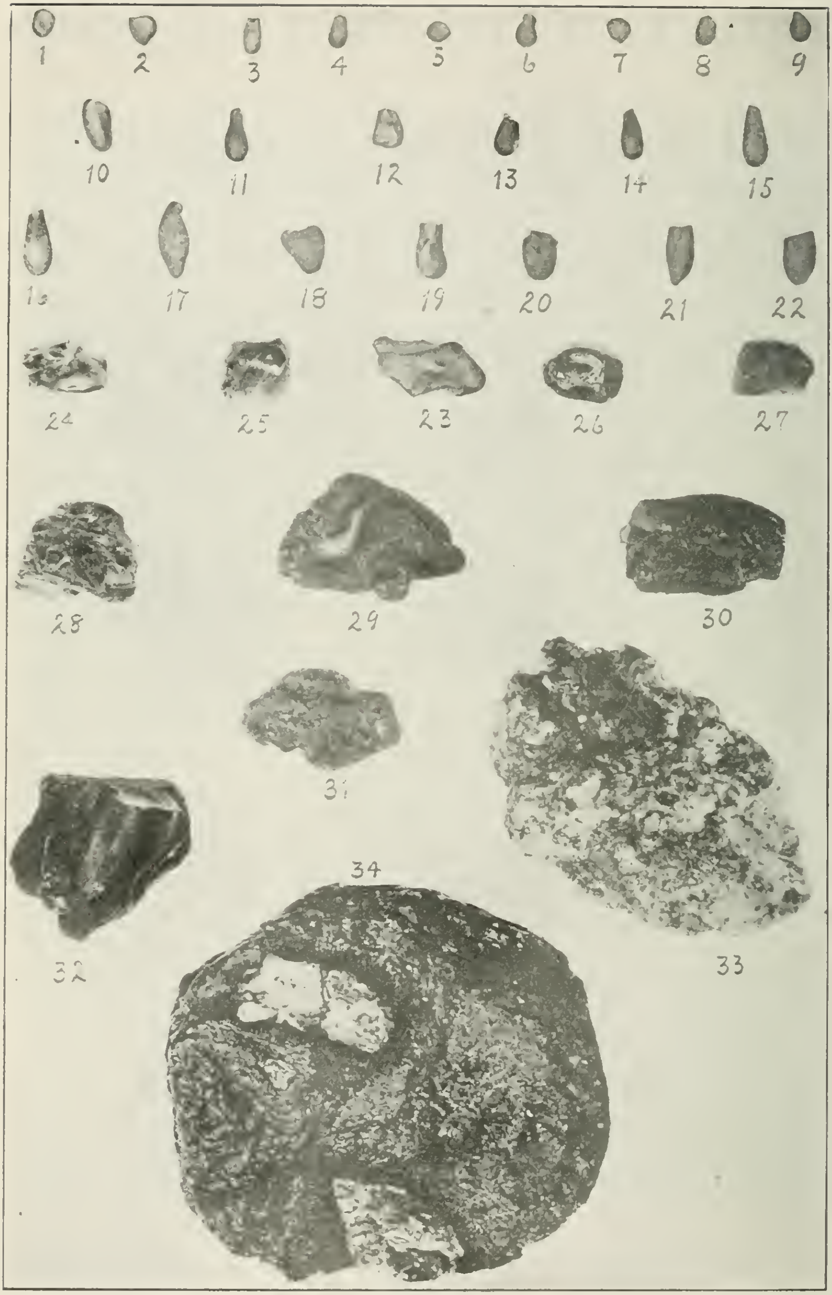
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Plate 3.

Figs. 1-23. Amber drops or "tears," Kreischerville, Staten Island, N. Y.
Figs. 24-33. Amber masses and fragments, Kreischerville, Staten Island, N. Y.
Fig. 34. Matrix containing amber, Kreischerville, Staten Island, N. Y.
(Figures are all natural size.)

article above quoted, also indulges in speculations concerning the kind of wood from which the amber was probably derived, and says (p. 13): "But I have not been able to ascertain the species to which it belongs."

Apparently nothing further was recorded in regard to the subject until 1830, when S. G. Morton published a paper entitled: "Synopsis of the Organic Remains of the Ferruginous Sand Formation of the United States, with Geological Remarks" (*Am. Journ. Sci.*, vol. 17, 1830, pp. 274-295) in which he mentions (p. 293) "vast deposits of lignite with amber," in the sections exposed in cuttings made for the Delaware and Chesapeake canal. Incidental reference to the above may also be found in a subsequent article "On the Analogy which exists between the Marl of New Jersey and the Chalk Formation of Europe" (*Ibid.*, vol. 22, 1832, pp. 90-95).

After this, for a period of some fifty years, our native amber apparently attracted but little attention, or at least there does not seem to have been anything additional recorded in regard to it during that time. A popular article, by Mrs. Erminnie A. Smith, entitled "Concerning Amber," was published in the *American Naturalist*, for March, 1880, in which the only reference in this connection is the following brief paragraph (p. 187): "Very little amber has as yet been found in the United States. Gay Head, Martha's Vineyard, Camden, N. J., and Cape Sable, Md., only are mentioned as its localities. A barrel full of small pieces was taken out of the greensand in New Jersey, which through some mistake was burned."

At a meeting of the New York Academy of Sciences, on February 5th, 1883, Mr. Geo. F. Kunz exhibited a mass of amber $\frac{3}{4}$ lb. in weight, which was said to have come from the Tertiary deposits of Nantucket, and read a paper "On a large Mass of Cretaceous Amber from Gloucester County, New Jersey," in which was described a mass weighing 64 oz., found in Kirby's marl pit, near Harrisonville (*Trans. N. Y. Acad. Sci.*, vol. 2, 1883, pp. 85-86). In the subsequent discussion of this paper Dr. J. S. Newberry is quoted as remarking that "in one pit [in Gloucester Co.] a whole barrel full had been found and burned by the workmen"; which remark probably has reference to the incident mentioned in Mrs. Smith's article. In the record of this discussion may also be found a statement, credited to Mr. W. E. Hidden, to the effect that amber had been discovered during the previous summer in the marl beds of North Carolina, and a hearsay reference to a very large specimen from New Jersey, which was "found on the shore of Raritan Bay, and now deposited in the museum at Berlin, Germany."

In 1885 were made the first discoveries of fossil plant remains in the Kreischerville clays (*Proc.* Nat. Sci. Assn. Staten Isld., Dec. 12th, 1885). These were subsequently described by the writer (*Ibid.*, Feb. 13th, 1886) and at the end of the descriptions may be found the following brief paragraph: "There are also little masses of a yellow substance which I take to be a fossil gum or amber." Mr. Wm. T. Davis also found it there subsequently, according to the following record: "Mr. Davis presented unusually fine specimens of lignite, apparently coniferous, from the clay beds of Kreischerville. The specimens were of the appearance and consistency of jet and contained considerable amber," (*Ibid.*, March 12th, 1892). The above mentioned material from Kreischerville was all found in the immediate vicinity of the deposits recently exposed and probably from parts of the same bed.

PROBABLE ORIGIN OF THE AMBER.

In 1894 the Cape Sable locality was visited by Mr. A. Bibbins, who succeeded in finding and collecting a number of specimens of amber, some of which were included in the interstices of a log of lignite and were evidently derived from it. This lignite was examined by Dr. F. H. Knowlton, by whom it was identified as a new species of Cupressinoxylon (*C. bibbinsi*), or in other words the fossil wood of a Sequoia ("American Amber-producing Tree," F. H. Knowlton, *Science*, vol. 3, 1896, pp. 582–584, figs. 1–4). This identification is important for the reason that it gives us definite information, for the first time, in regard to the origin of at least a portion of the amber in this part of the United States, and suggests a probable source for some of that at Kreischerville, where it occurs in close connection with the leafy twigs of *Sequoia heterophylla* Vel., and *S. reichenbachi* (Gein.) Heer. It may also be of interest to note that leaves of Sequoia are said to be associated with the amber of Japan.

Other coniferous remains which have been found in the Kreischerville clays, and which may have contributed to our supply of amber, are *Widdringtonites reichii* (Ett.) Heer., *Juniperus hypnoides* Heer, *Dammara microlepis* Heer., and Pinus sp. The genus Dammara is prominently represented in our living flora by *D. australis* Lamb, the well known "Kauri" gum tree of Australia. Its former existence, however, as an element in the Cretaceous flora of North America, is somewhat problematic, and is based entirely upon the presence of certain small cone scales, the exact botanical affinities of which have never been satisfactorily determined. The occurrence of remains of the genus Pinus is more significant perhaps than any of the other three last mentioned, by reason of the fact that the typical amber of the Baltic provinces in Europe is recognized as a product of the extinct Tertiary species, *P. succinifera* (Goepp.) Conw.

ACKNOWLEDGMENTS.

For answers to letters of inquiry on my part I am indebted to Dr. Lester F. Ward and Dr. F. H. Knowlton of the United States National Museum, Mr. A. Bibbins of the Woman's College of Baltimore, Mr. L. P. Gratacap and Mr. Barnum Brown of the American Museum of Natural History, and to Mr. Geo. F. Kunz, of the United States Geological Survey.

CONTRIBUTIONS FROM THE NEW YORK BOTANICAL
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THE POLYPORACEAE OF NORTH AMERICA—X.

AGARICUS, LENZITES, CERRENA, AND FAVOLUS

By WILLIAM A. MURRILL

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[From the BULLETIN OF THE TORREY BOTANICAL CLUB, 32: 83-103. 1905.]

The Polyporaceae of North America — X. Agaricus, Lenzites, Cerrena, and Favolus

WILLIAM ALPHONSO MURRILL

Plants with variable daedaleoid or lamelloid hymenium and light-colored context and spores form the subject of the present article. These plants, like those of the genus *Sesia* discussed in article IX, recognize none of the ordinary specific or even generic limitations of the group and must be treated in a class by themselves. If they were amenable to ordinary methods of cultivation, they would surpass *Oenothera* in supplying most excellent examples of mutation.

Through the genus *Favolus*, taken up at the close of this paper, we return to the normal poroid forms of the family.

AGARICUS (Dill.) L. Sp. Pl. 1176. 1753

Striglia Adans. Fam. Pl. 2: 10. 1763.
Daedalea Pers. Syn. Fung. 499. 1801.
Daedaleopsis Schroet. Krypt. Fl. Schles. 3: 492. 1888.

The type of the genus *Agaricus* is *Agaricus quercinus* L. This is the only species common to Linnaeus and Dillenius, the author of the genus. Primarily, the name *Agaricus* was applied to dimidiate woody forms and the application of the present code* restores it to one division of this group. It is unfortunate that the association of fleshy and woody forms by Linnaeus under the name *Agaricus* has entirely diverted it from its earlier use and made necessary a number of changes in its restoration. Such changes could be avoided in only one way, *i. e.*, by applying canon 15 (f) of the code, which allows a well-known economic species to be selected as the type in order to avoid change in the current application of a Linnaean generic name. *Agaricus campestris* is such a species and *might* be adopted as the type of the genus *Agaricus*. I hesitate, however, to make use of a provision designed especially for *Poa pratensis*. I fear also that this provision, being the only one of its kind in the code, is in danger of being overworked. Moreover, I have good reason to know that a mere makeshift of this kind will never be accepted by working mycologists as permanent. *Agaricus*, then, properly figures as a genus of the *Polyporaceae*.

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* Bull. Torrey Club, 31: 249-261. 1904.

The genus *Striglia* was founded by Adanson upon Batarra's *plate 38*, which represents several common species of *Agaricus*, the first being *A. quercinus* L.

Daedalea of Persoon was founded on *D. quercina* (L.) and four other species, one of them being *D. confragosa*. Batarra is quoted at some length and *plate 38* cited by Persoon, but no mention is made of *Striglia*, based on the same plate.

Daedaleopsis, founded upon the single species *Daedalea confragosa* (Bolt.), completes the list of synonyms.

Species belonging to the genus *Agaricus* have white or wood-colored context, hyaline spores and poroid, daedaleoid or lamelloid tubes. One rare species, *A. juniperinus*, occurs on coniferous wood; all the others are found abundantly on decaying wood of various deciduous trees. One species, *A. deplanatus*, is tropical; the rest occur in the United States and Canada, and two of these are found also in Europe. Most of the species, in spite of the remarkable variability of some of them, are easily distinguished; *A. Aesculi* and *A. deplanatus*, however, approach very near each other in some of their forms.

Synopsis of the North American species

1. Tubes one to several millimeters in transverse diameter; surface usually brown or discolored; plants found in temperate regions. 2.
Tubes less than one-half millimeter in transverse diameter; surface white or yellowish; plants found in the southern states or the tropics. 3.

2. Pileus thick, triangular, margin obtuse; tubes large, daedaleoid, dissepiments obtuse; context wood-colored; plants abundant on oak. 1. *A. quercinus.*
Pileus thick, triangular, margin obtuse; tubes large, daedaleoid, dissepiments obtuse; context white; plants rare on red cedar. 2. *A. juniperinus.*
Pileus thin, applanate, multizonate, margin very acute; hymenium poroid, daedaleoid or lamelloid, dissepiments acute. 3. *A. confragosus.*

3. Pileus reniform, rigid, usually azonate; plants found in the southern states. 4. *A. Aesculi.*
Pileus thin, flexible, variously shaped, usually multizonate; plants confined to the tropics. 5. *A. deplanatus.*

1. AGARICUS QUERCINUS L.

Agaricus quercinus L. Sp. Pl. 1176. 1753.—Sow. Engl. Fung. *pl. 181.*
Agaricus labyrinthiformis Bull. Herb. Fr. *pl. 352.* 1787.
Daedalea quercina Pers. Syn. 500. 1801.
Polyporus latissimus Fr. Obs. **1**: 128. 1815.
Daedalea quercina var. *nigricans* Fr. Syst. **1**: 333. 1821.

This very common species has been known from ancient times on account of its size and abundance and because it grows on stumps and timbers in conspicuous places. The abundant use of oak, its favorite host, brings it to the attention of many. Bauhin and other prelinnaean botanists seem to have been impressed with the striking appearance of its hymenium, expressed by Linnaeus in his "Agaricus acaulis, lamellis labyrinthiformibus" and by Bulliard in his choice of a specific name. The figure on Batarra's plate 38 is a rather old blackened form of this species, distinguished by him as a variety and cited by Fries as var. *nigricans*. *Polyporus latissimus* was described by Fries from resupinate forms frequent on structural oak timbers before he was well acquainted with the variations of the species. As this species is so extremely common and well-known, it is not considered necessary to give a list of available collections. All the exsiccati contain specimens of it, and one can hardly fail to find it at any season of the year on some oak stump or decaying trunk.

2. **Agaricus juniperinus** sp. nov.

Sporophore corky, sessile, attached by a broad, often decurrent, base, composed of imbricate, terraced or laterally connate, ungulate pilei 2–5 × 2–7 × 1.5–3 cm.; surface irregular, anoderm, finely tomentose, yellowish-white, becoming cinereous with age; marginal edge fertile, concolorous, not rounded, but often forming an obtuse angle: context corky, white, concentrically banded, 0.5–1 cm. thick; furrows large, labyrinthiform, radially, rarely otherwise, elongated, 0.5–2 cm. long, 1–3 mm. wide, white or pallid, edges obtuse, often splitting into broad irpiciform plates: spores smooth, hyaline, ovoid, 3–4 × 5–6 μ.

The type plants of this species were collected by Bartholomew on a red cedar stump near Rockport, Kansas, November 8, 1894. It was again collected by Bartholomew on the same host but in a different locality in 1896, and Demetrio found it in Cole County, Missouri, September, 1898, growing in a decayed spot on a living red cedar trunk.

The nearest American congener of this species is probably *A. quercinus*, from which it may be easily distinguished by its milk-white context. It is also known only on red cedar, while *A. quercinus* occurs on the wood of deciduous trees.

3. **Agaricus confragosus** (Bolt.)

Boletus confragosus Bolt. Halifax Fung. Suppl. **3**: 160. *pl. 160.* 1791.
Daedalea confragosa Pers. Syn. 501. 1801.
Daedalea rubescens Alb. & Schw. Consp. Fung. 238. *pl. 11. f. 2.* 1805.
Daedalea albida Schw. Syn. Car. 67. 1818. Fr. Not *D. albida.*
Daedalea zonata Schw. Syn. Car. 68. 1818.
Daedalea discolor Fr. Elench. Fung. 68. 1828.
Daedalea discolor Kl. Linnaea **8**: 481. 1833.
Daedalea corrugata Kl. Linnaea **8**: 481. 1833.
Trametes rubescens Fr. Epicr. 492. 1836.
Lenzites Klotzschii Berk. Ann. Mag. Nat. Hist. **7**: 452. 1841.
Lenzites Crataegi Berk. Lond. Jour. Bot. **6**: 323. 1847.
Lenzites unguliformis B. & C. Hook. Jour. Bot. **1**: 101. 1849.
Lenzites bicolor Fr. Nov. Symb. 43. 1851.
Lenzites Cookeii Berk. Grevillea **4**: 161. 1876.
Lenzites proxima Berk. Grevillea **4**: 162. 1876.

This remarkable species has a literary history in keeping with its wonderful variation in nature. Bolton appears to have the credit of noticing it first, and, fortunately, his description and figures are excellent. He speaks of it as growing on stumps and the dead roots of trees at Fixby-Hall, the type locality, and other places in Halifax. His description is here given :

"Boletus coriaceo lignosus sessilis dimidiatis, supra scabroso zonatus subfuscus, carne ferrugineo-pallide, tubis cinereis poris multiformis."

Persoon made use of Bolton's name, but does not seem to be clear as to the identity of the plant in question. Albertini and Schweinitz described it under the name of *D. rubescens*, at the same time questioning whether it might not be the same as *D. angustata* (Sow.) Fr. Schweinitz again described the thin forms met with in Carolina under different names, which were much discussed by European mycologists.

Fries changes one of Schweinitz's specific names to *D. discolor* in his Elenchus, because it was preoccupied by one of his own. Type plants of this species grew on birch trunks. A little later, Klotsch finds a specimen in Hooker's herbarium collected by Dr. Richardson on a birch trunk in boreal North America, which he determines as *D. discolor* Fr., but Fries disclaims it and calls it *D. discolor* "Kl. *nec* Fr." Then Berkeley throws the species into *Lenzites* and names it after Klotsch. This is only the beginning of Berkeley's career in connection with *D. confragosa*, for we find him between this time and 1876 assigning four new names to different specimens of this species, *L. Crataegi* to plants collected in Ohio by Lea, *L. unguliformis* to specimens sent from North Carolina by Curtis, *L. Cookeii* to Peck's specimens collected on willow and birch in New York and *L. proxima* to New York plants collected by Sartwell. *L. Lyallii* Berk. from Vancouver also seems to be a form of this species, but the type plants are in such poor condition that it is impossible to determine this with certainty.

A form found in Mexico by Schiede and recently duplicated by Smith appears to have as much claim to distinction as any yet reported, if it were only possible to separate it from thin lenzitoid forms found in the Southeastern states. In describing this form in 1851, as *L. bicolor*, Fries says that he had received the same thing from Curtis in South Carolina under the name of *D. tricolor*. A full discussion of this and several other varieties, by Peck, may be found in the 30th Report of the N. Y. State Museum of Natural History; on page 73 the author summarizes the forms discussed which have received specific names as follows:

"*Daedalea confragosa* Pers. which is represented by forms of our plant having a scabrous somewhat zoned pileus of a reddish-brown color and a daedaleoid hymenium."

"*Trametes rubescens* A. & S. which is represented by forms that assume the ruddy color and have the trametoid hymenium."

"*Lenzites Crataegi* Berk. which is represented by forms having a shining pileus attached by the vertex and having a trameto-lenzitoid hymenium."

"*Lenzites Cookei* Berk. which is represented by forms with the pileus of a cervine hue and with a trameto-lenzitoid hymenium."

"*Lenzites proxima* Berk. with the thin flattened pileus completely overspread by the peculiar tomentum previously described."

Peck considers all these varieties of one protean species and suggests that the specific names under which they were described be retained as varietal names.

After the study of a quantity of material, including most of the original type collections, and numerous observations of various stages of this plant in the field, I am forced to confess that in spite of its wonderful variation in size as well as in general appearance, I find it impossible to make more than one species of it. When the ordinary form common in New York is compared with specimens from the Carolinas only 1 cm. in diameter and they in turn with large, thick poroid forms from Florida or very thin, expansive lenzitoid forms from Mexico, one at once concludes that he is dealing with different plants; but let a large array of specimens from different localities be examined and all the specific distinctions seem to disappear in well-graded intermediate forms which are with difficulty set aside. It is not strange that the foreign mycologists who had only isolated specimens to deal with should have erected so many species.

In examining European forms, some are easily recognizable as distinct from those seen in America, but, knowing this plant as we do at home, who shall attempt to separate any of them specifically!

This species is met with abundantly about New York growing on dead trunks or branches of sweet gum, willow, birch, oak, dogwood, alder, beech and other deciduous trees and shrubs. The tubes are usually daedaleoid, sometimes porous, when young, very pale flesh-colored, turning at once to yellowish-brown when bruised. The surface is light to dark yellowish-brown and the margin, which is lighter, shows fan-like radiations of growth. Zones may or may not be present. As the fruit becomes older, the tubes very often become lenzitoid and various changes take place in the appearance of the surface. The spores are hyaline, cylindrical, $9 \times 2\ \mu$.

The following collections will indicate the wide range of the species in North America: Rav. Fung. Car. Fasc. 2. nos. *15* and

416; Ell. & Ev. N. A. Fung. *1924*, *1925*, *1926*, *1927*, *1928*; Underw. & Cook, Illus. Fung. *18*; Shear, N. Y. Fung. *40*; Canada, *Macoun*, *Dearness*; Maine, *Blake*, *Miss White*; Connecticut, *Seymour*, *Earle*, *Miss White*, *Underwood*; New York, *Barbour*, *Peck*, *Mrs. Britton*, *Underwood*, *Earle*, *Murrill*; New Jersey, *Martindale*, *Earle*, *Anderson*, *Murrill*; Delaware, *Commons*; Pennsylvania, *Stevenson*, *Sumstine*, *Gentry*; Maryland, *Miss Banning*, *Shear*, *Ricker*; Virginia, *Murrill*; North Carolina, *Memminger*; Georgia, *Harper 2037a*, *2042e*; Alabama, *Earle*, *Baker*; Louisiana, *Langlois*; Florida, *Calkins*; Ohio, *Morgan*; Tennessee, *Murrill 594*, *607*; Kansas, *Bartholomew*; Wisconsin, *Baker*; Texas, *Hodson*.

4. **Agaricus Aesculi** (Schw.)

Boletus Aesculi flavae Schw. Syn. Fung. Car. 70. 1818.

Polyporus Aesculi Fr. Elench. 99. 1818.

Trametes incana Berk. Lond. Jour. Bot. **4**: 305. 1845. Not *T. incana* Lév.

Daedalea ambigua Berk. Lond. Jour. Bot. **4**: 305. 1845.

Trametes ambigua Fr. Nov. Symb. 96. 1851.

Trametes lactea Fr. Nov. Symb. 96. 1851.

Lenzites glaberrima B. & C. Grevillea **1**: 34. 1872.

Daedalea glaberrima B. & C. Grevillea **1**: 67. 1872.

Trametes Berkeleyi Cooke in Sacc. Syll. Fung. **9**: 194. 1891.

The first description recorded of this species is that made by Schweinitz in his Synopsis under the name of *Boletus Aesculi flavae*, which is as follows:

"B. minor subimbricatus, pileo dimidiato duriusculo fornicato glabriusculo pallido margine sterili, poris minutis sulphureis."

"In arboribus, imprimis *Aesculi flavae* Wilkes County, ad ripam Yadhin. Caespites duas tresve uncias longi. Parum imbricatus, fere simplex. Pileus suberosus, subtenuis, basi crassior, glaber, tactu subtomentosus. Pori demum nigrescunt."

This is not a good description of the plant. Several statements in it are misleading as well as incomplete. It is possible that Schweinitz confused this species with one ordinarily known as *P. hemileucus*, rather common in the Carolinas. This supposition would account for Fries' remark with reference to the specimen sent him by Schweinitz that it was "*rubiginosus*." However, the plant in the Schweinitz herbarium is undoubtedly *Daedalea ambigua* and not *P. hemileucus,* which settles the question of type.

Trametes incana Berk. was founded on specimens collected by Lea on dead trunks of trees in Ohio. These specimens were possessed of a very short lateral, disciform stem, a yellowish hymenium and roundish, or rarely linear and sinuous, pores. The name was changed to *Trametes Berkeleyi* in 1891 by Cooke because of *Polyporus* (*Trametes*) *incana* Lév. (Bonite, Crypt. 183. 1844–1846), described from the Philippines. Although *Trametes* seems to be used here as a subgenus, the author writes it as a genus lower down on the same page when he comes to refer to and describe the figures: "*Pl. 137. f. 2. Trametes incana* de grandeur naturelle," etc.

Daedalea ambigua was described by Berkeley in almost the same breath with the previous species and the specimens were collected in the same locality by Lea. Montagne considered the two species the same, but Berkeley, influenced to a considerable extent by Lea, finally decided to make them distinct because of the narrow, sinuous pores of the latter.

Trametes lactea was described from plants sent to Fries from Carolina by Curtis. These plants were evidently porous forms of this species and naturally fell under the genus *Trametes* so far as Fries could determine from the material.

Lenzites glaberrima was also described from Carolina material sent by Curtis. This time the tubes were lenzitoid and anastomosing and there was an orbicular disc for the base.

Daedalea glaberrima was meant by Berkeley for an entirely distinct species. The pores are described as "at length sinuous" and the stem as "lateral, one-half an inch long and wide." The type specimens were sent from South Carolina by Curtis.

In addition to the above, several other names have been used quite freely by collectors and systematists in connection with this species. *Trametes marchionica*, for example, described from the Marquesas Islands by Montagne (Voy. Pole Sud, 204. 1845), is often treated as a synonym of *D. ambigua. Trametes Mülleri* Berk. is applied to Cuban forms of *D. ambigua* at Kew and elsewhere, although the type locality of the species is the Victoria

River, Australia. There is ample excuse for this, however, in the fact that this species is described in a work on Cuban fungi and is undoubtedly considered by the author to exist in Cuba; nevertheless, since no definite statement to this effect nor the citation of a collector's number accompanies the description, the type locality as given and also as implied in the personal specific name must be considered the correct one for the species. There exists a very close relationship between the various forms of *D. ambigua* and species described from regions of the Orient, but a discussion of this relationship is beyond the scope of the present article.

As one may judge from the above discussion, *Agaricus Aesculi* is a variable species and liable to confuse the collector who relies too much upon regularity of pore-structure. If one considers the variability of the genus, however, he will have little trouble in distinguishing it by color, surface and size. It is found on stumps, trunks, and other forms of decaying wood of oak, sycamore, etc., in the Southern states. Specimens are at hand from Missouri, *Demetrio*; Kansas, *Bartholomew*; Ohio, *Morgan*, *Lloyd*; South Carolina, *Ravenel*; Florida, *Martin*, *Rau*, *Calkins*, *Lloyd*; Texas, *Hodson 320*.

5. **Agaricus deplanatus** (Fr.)

Daedalea elegans Spreng. Vet. Acad. Handl. 51. 1820. — Fr. Syst. **1**: 335. 1821; Elench. 69. 1828. Not *Agaricus elegans* Scop. Fl. Carn. ed. 2. **2**: 438. 1772.

Daedalea deplanata Fr. Linnaea **5**: 513. 1830.

Lenzites deplanata Fr. Epicr. 404. 1838.

Trametes elegans Fr. Epicr. 492. 1838.

Trametes centralis Fr. Nov. Symb. 95. 1851.

The name *Daedalea elegans* was first assigned to plants found on tree trunks in Guadeloupe. Sprengel's original description is as follows:

"D. coriaceo-lignosa sessilis, pileo supra albido glaberrimo, subtus alutaceo, lamellis anastomosantibus in poros marginales abeuntibus."

This was enlarged by Fries after the study of a considerable variety of forms. Ten years later Fries himself described another form of the same species collected by Beyrich in Brazil under the name of *Daedalea deplanata*. His *Trametes centralis*, also a synonym, is based upon collections made in the West Indies, Costa Rica and Mexico, in which the sporophores are sessile at the center, with pores decurrent to the base.

Other species, either synonymous or closely related to those above described, but purposely kept separate at this time from North American forms are as follows:

Daedalea amanitoides Palis. de Beauv. Fl. Owar. **1**: 44. *pl. 25.* 1804. *Daedalea Palisoti* Fr. Syst. **1**: 335. 1821. *Lenzites Palisoti* Fr. Epicr. 404. 1838. Afzel. Fung. Guin. **1**: *pl. 11. f. 23. a, b.* The species was described from Oware, growing on trunks. I know of no reason for changing the specific name to *Palisoti.*

Daedalea repanda Pers. Freyc. Voy. 168. 1826. Mont. Cuba 382. *pl. 14. f. 4.* 1842. *Lenzites repanda* Fr. Epicr. 404. 1838. (Not *Agaricus repandus* Bull.) Described from the island of Rawak as "D. latissima albido-pallens, pileo glabro zonato margine repando, sinulis angustis densis, margine subdentatis." Montagne adopts the name for Cuban specimens and cites *D. polita, D. deplanata, D. laevis, D. applanata, D. Palisoti* and *D. indica* as synonyms. He appears to have given considerable attention to the various forms in Cuba with reference to growth and variation.

Daedalea polita Fr. Linnaea **5**: 514. 1830. *Lenzites polita* Fr. Epicr. 404. 1838. Described from specimens in the herbarium of Willdenow collected by Bory on Bourbon, or Reunion, Island. The type in Fries' herbarium has the exact contour of *A. Aesculi*, but is thinner. The surface is like that of *A. Aesculi*, but the pores are more like those of *A. deplanatus.*

Daedalea applanata Kl. Linnaea **8**: 481. 1833. *Lenzites applanta* Fr. Epicr. 404. 1838. Collected on trunks in the island of Mauritius by Telfair and described from the herbarium of Hooker. The author questions if it is not *D. deplanata* Fr. or *D. polita* Fr.

Polyporus (*Trametes*) *lactineus* Berk. Ann. Mag. Nat. Hist. **10**: Suppl. 373. 1843. Described from specimens collected by Koenig in Ceylon and named by him in herbarium "*Boletus lacteus.*" Berkeley does not distinguish it from forms found in the West Indies.

Lenzites platypoda Lév. Bonite, Crypt. 184. 1844–1846. This appears to be in no way specifically distinct from *Daedalea repanda*

Pers., but the author, who was at that time but little acquainted with oriental forms, thinks that the stipe and pores sufficiently distinguish it from Persoon's species.

This exceedingly variable and very attractive species is abundant on decaying wood in tropical America. In some localities the young sporophores, although tough, are used as food by the natives. It differs from *A. Aesculi* in being thin and flexible and usually much more zonate, though at times the two species are not easily distinguished. One is here forcibly reminded of *Pycnoporus cinnabarinus* and *Pycnoporus sanguineus*, which exhibit much the same relations, indicating that the effect of tropical conditions may be to produce a thinner, more expanded and more zonate sporophore.

Specimens are at hand from Florida, *C. G. Lloyd;* Bahamas, *Mrs. Britton 773, 847;* Porto Rico, *Wilson 294;* Hayti, *Nash 234, 240;* Cuba, *Underwood & Earle 1522, Hamilton;* Mexico, *Egeling;* Nicaragua, *Smith;* British Guiana, *Millspaugh 13529;* Honduras, *Wilson 411;* Yucatan, *Millspaugh 57800;* Colombia, *Baker.*

SPECIES INQUIRENDAE

Daedalea subtomentosa Schw. Syn. Fung. Car. 68. 1818. Described from North Carolina material as follows:

"D. minor gibbosa, zonis elevatis subtomentosis albida, sinubus poriformibus angustis albis et pallidis. Passim. Species non valde distincta. Pileus glaber tuberculosus."

This is very probably another synonym of *A. confragosus*, but I have not been able to find type material. Even Schweinitz himself says that it is not a very distinct species.

Irpex maximus Mont. Ann. Sci. Nat. II. Bot. 8: 364. 1837. Syll. Crypt. 174. 1856. *Polyporus labyrinthicus* Mont. Cuba, 406. 1842 (not *P. labyrinthicus* Fr. Elench. 83. 1828).

This species was described from material collected by Ramon de la Sagra on the trunks of trees in Cuba. Montagne's earlier description is as follows:

"Pileo coriaceo tenui reniformi plano-convexo velutino marginem versus repandum acutum concentrice sulcato demum basi glabrescenti subradiato dentibusque confertis acutis pubescentibus ochroleucis."

"Pileus 8 poll. transversim latus, 6 poll. longus, vix lineam semis cum dentibus crassus, subtus vel ad marginem prolifer. Eximie distincta species nec cum ulla alia confundenda."

Before the appearance of his work on Cuban cryptogams, Montagne seems to have changed his mind regarding the distinctness of this species and in that work adopts Fries' name and description for his plant.

Lenzites tenuis Lév. Ann. Sci. Nat. III. Bot. **5**: 122. 1846. Collected on trunks in Guadeloupe and thus described:

"Pileo subflabellato coriaceo azono nudo pallide ochroleuco postice fuscescente margine acutissimo lobato quandoque prolifero, lamellis rectis dichotomis anastomosantibus acie acutis concoloribus."

"Cette espèce est voisine du *Lenzites polita*, dont elle diffère par le peu d'épaisseur du chapeau et la ténuité des lames; la marge, qui est très mince, donne quelquefois naissance à d'autres petits chapeaux. Il atteint de 8 à 10 centimètres dans son plus grand diamètre."

This species resembles thin forms of *Agaricus confragosus*, but more material is needed to determine its exact relations.

Daedalea violacea Lév. Ann. Sci. Nat. III. Bot. **5**: 142. 1846. Described from specimens collected on trunks in Cuba as follows:

"Pileo coriaceo applanato semi-orbiculari nudo inaequabili zonato lurido e basi ad marginem patentem acutum lobulatum fibroso-radiato, sinubus minutissimis anastomosantibus violaceis."

"Chapeau coriace, large de 12 à 14 centimètres, épais de 5 millimètres, à surface zonée, nue, inégale, marquée de stries qui naissent de la base et s'étendent à la marge. Cette espèce de *Daedalea* rappelle par la ténuité des sinus ceux de l'*Hymenogramme javensis*, et présente sur les deux faces une couleur violette semblable à celle du *Polyporus Auberianus*. On ne peut cependant confondre ce *Daedalea*, quoique du même pays, avec ce dernier, dont les pores sont ronds."

Daedalea plumbea Lév. Ann. Sci. Nat. III. Bot. **5**: 302. 1846. Described from plants collected on trunks in New York as follows:

"Pileo sessili reniformi vel semi-orbiculari coriaceo depresso zonato inaequabili nudo plumbeo, sinubus lamellosis labyrinthiformibus laxis obtusis fuscis, contextu concolori."

"Chapeau coriace, semi-orbiculaire ou réniforme, large quelquefois de 2 décimètres: sa marge tend constamment à se relever. La surface est nue, tuberculeuse, d'un gris plombé; les sinus sont àpeu près semblables à ceux du *Daedalea quercina*, mais d'une couleur obscure, ainsi que le parenchyme du chapeau."

The above description indicates that the author was possibly dealing with old and darkened specimens of *Agaricus quercinus*.

Daedalea puberula B. & C. Grevillea **1**: 67. 1872. Described from plants collected in Pennsylvania by Michener as follows:

"Pileo molli-suberoso, irregulari, dimidiato, hic illic tuberculoso, puberulo, ochraceo; margine tenui: poris parvis demum sinuatis."

"About 4 inches across; irregular, corky, of a soft substance, which is slightly zoned, attached behind, and more or less decurrent, even, with the exception of a few obtuse, tubercular, elevations, finely pubescent; ochraceous; pores about 1/50 inch across, sinuated; of the same colour as the pileus."

LENZITES Fr. Gen. Hymen. 10. 1836

This genus, dedicated to Lenz, was described by Fries as follows:

"Lamellae coriaceae, radiantes, nunc simplices, nunc poroso-anastomosantes, acie compaginatae; dissepimento pileo floccoso."

Fries lists only three species, *L. betulina*, *L. abietina* and *L. heteromorpha*, the first of which we consider the type. As at present limited, the genus contains only two North American species, one very abundant in the United States and Canada and the other known only from Cuba.

Synopsis of the North American species

Surface of the pileus conspicuously tomentose.	1. *L. betulina.*
Surface of the pileus finely pubescent.	2. *L. cubensis.*

1. LENZITES BETULINA (L.) Fr.

Agaricus betulinus L. Sp. Pl. 1176. 1753. — Sowerby, Eng. Fung. *pl. 182.* 1799.

Daedalea betulina Rebentisch, Prodr. Fl. Neom. 371. 1804. — Fr. Obs. **1**: 104. 1815.

Lenzites betulina Fr. Gen. Hymen. 10. 1836.

Linnaeus describes this species as "Agaricus acaulis coriaceus villosus: margine obtuso, lamellis ramosis anastomosantibus." "Fl. Suec. 1085. Habitat in Betulis." Later botanists also described it under various other names. The plant is exceedingly common and is so well known as to need no description, being found in abundance on old stumps, fallen branches and other forms of deciduous wood throughout the north temperate zone. Fries says in his Epicrisis that it is confined to deciduous wood, but Peck states that it occurs also on that of evergreen trees. I have never seen it growing upon coniferous wood, but many of our fungi that normally occur upon deciduous wood have been known to attack that of dead conifers in the vicinity, or, in barren regions, when hard pressed for food.

The following specimens are listed in order to give some idea of the range of this species: Finland, *Karsten;* Germany, *Sydow;* Massachusetts, *Porter;* New York, *Britton, Murrill;* New Jersey, *Ellis, Mrs. Lobenstine;* Pennsylvania, *Barbour;* Virginia, *Murrill;* Tennessee, *Murrill 636;* South Carolina, *Ravenel;* Alabama, *Earle & Baker;* Missouri, *Demetrio;* Kansas, *Bartholomew;* Michigan, *Hicks;* Wisconsin, *Baker;* Montana, *Mrs. Fitch.* Many other collections and most of the published exsiccati contain good examples of this fungus.

2. LENZITES CUBENSIS B. & C.

Lenzites cubensis B. & C. Jour. Linn. Soc. Bot. **10**: 303. 1868.

Described from plants collected by Wright in Cuba on dead wood as follows:

"Pileo duro ligneo dimidiato subvelutino cervino zonato rugoso; stipite nullo vel brevissimo; lamellis repetite furcatis crenatis vel crispis concoloribus latioribus."

"Pileus 2½ inches broad and 1½ inches long."

Nothing is known of this species beyond the above description and a few type specimens still to be seen at Kew and Paris. It appears, however, to belong with our common species, *L. betulina*, from which it may at once be distinguished by its almost glabrous surface. It is no doubt rare and possibly confined to the higher altitudes of Cuba.

SPECIES INQUIRENDAE

Lenzites Berkeleyi Lév. Ann. Sci. Nat. III. Bot. **5**: 122. 1846. Based upon plants collected by Ménand in New York. *Daedalea betulina velutina* Berk. (Ann. Mag. Nat. Hist. **3**: 381. 1839) is cited as a synonym and doubtless accounts for the specific name adopted. Berkeley's description is as follows:

"Pileus hard, sessile, dimidiate, lobed, deeply zoned, tawny, velvety. Gills rather thick."

"New Orleans and other parts of North America. Hooker Herbarium. The pileus is by no means tomentose, but clothed with very short close velvety pubescence. Vertex sometimes lengthened out into a sort of stem. *Thelephora lobata* varies in the same way."

Léveillé's description of the species is as follows:

"Pileo coriaceo flexili subreniformi sessili hirsuto fulvo zonis confertis prominentibus notato, lamellis latissimis distantibus acie integris ochroleucis."

"Chapeau presque réniforme, coriace, large de 4 à 8 centimètres, d'une belle couleur fauve, avec des zones saillantes et assez rapprochées; les lames sont très larges, comparées à l'épaisseur du chapeau, jaunes, à marge tranchante et entière."

In their Commentary on Schweinitz' Synopsis, Berkeley and Curtis determine no. 486, "*D. an gibbosa*, ?" as *Lenzites Berkeleyi* Lév.

CERRENA S. F. Gray, Nat. Arr. Brit. Pl. **1**: 649. 1821

This genus was founded upon *Cerrena cinerea* (Pers.), a single species. The very brief generic description, "Stem distinct: cap semicircular," is followed by the citation of two synonyms and a short description of the species. Although the descriptions are unsatisfactory, the citations point very plainly to a definite and well-known species as the type of the genus.

CERRENA UNICOLOR (Bull.) Murrill

Boletus unicolor Bull. Herb. France, *pl. 408.* 1788. *pl. 501.* 1791. — Bolt. Hist. Fung. Halifax, Append. 163. *pl. 163.* 1791. — Sowerby, Eng. Fung. *pl. 325.* 1801.
Boletus decipiens Schrad. Spic. 169. 1794.
Sistotrema cinereum Pers. Syn. 551. 1801.
Daedalea unicolor Fr. Syst. **1**: 336. 1821.
Phyllodontia Magnusii Karst. Hedw. **22**: 163. 1883.
Cerrena unicolor Murrill, Jour. Myc. **9**: 91. 1903.

This species was first described from France by Bulliard. The ordinary form has been known for a long time, but European mycologists were considerably puzzled in 1876 by the discovery of a peculiar hydnoid form on a birch stick in the fern house at

Berlin. Specimens were sent to various mycologists and one of them was described by Karsten as *Phyllodontia Magnusii*, in honor of the discoverer, and became the type of a new genus. Hennings later found specimens of the same form in the same place, and traced their connection with *Daedalea unicolor*.

Cerrena unicolor is extremely abundant on stumps, logs and various other forms of decaying deciduous wood in the north temperate zone. New pilei form early in the season from the old ones, the surface being at first light yellowish-white and very hairy, becoming gray with age. The tubes are porous in very young stages, but soon unite into complicated labyrinthiform channels and later split up into teeth resembling those found in the *Hydnaceae*. No choice beyond deciduous wood is apparent as regards host; oak, beech, poplar, walnut, hickory, birch, elm, apple and various other broad-leaved trees serving as food when dead or decayed.

Specimens have been examined in all the published exsiccati that pretend to exhibit northern plants of this group. From the following list a good idea may be gained of the wide range of the species: Russia, *Jaczewski;* Sweden, *Romell;* Germany, *Magnus;* Austria, *Bresadola;* France, *Patouillard;* Newfoundland, *Waghorne;* Maine, *Ellis*; New Hampshire, *Gerard, Blake, Jeffries;* Massachusetts, *Miss Minns;* New York, *Shear, Ellis, Underwood, Earle, Peck, Murrill;* New Jersey, *Ellis, Underwood, Earle, Murrill;* Pennsylvania, *Herbst, Stevenson, Small, Banker;* Delaware, *Commons;* West Virginia, *Nuttall;* Virginia, *Murrill 252;* Ohio, *Morgan, Lloyd;* Illinois, *Mrs. Roy;* Missouri, *Demetrio;* Kansas, *Cragin;* Michigan, *Pieters, Wood;* Iowa, *Holway.*

SPECIES INQUIRENDAE

Daedalea tortuosa Cragin, Bull. Washburn Lab. Nat. Hist. 1: 26. 1884. Jour. Myc. 1: 28. 1885. Described from specimens collected on rotten logs at Topeka, Kansas, as follows: "Pilei dimidiate, convex, often imbricated and confluent, between corky and woody, strigose-roughened, pale yellowish-brown, becoming smoother and paler, internally concolorous, zonate, one-twelfth to one-eighth of an inch thick, usually once or twice sulcate near the acute, minutely repand, ferruginous-brown margin.

(Margin sometimes concolorous.) Hymenium pale cinnamon-brown, generally effused at the base and abruptly sub-porous at the margin. Sinuses labyrinthiform, flexuose, intricate, torn and toothed; very similar to those of *D. unicolor* Fr., except in color and much larger size. The largest single pilei observed measure about two inches in length by three in breadth."

Authentic specimens of this plant have not been seen, but there appears to be little in the description to distinguish it from forms of *Cerrena unicolor*.

FAVOLUS Beauv. Fl. Owar. **1**: 1. *pl. 1.* 1805.

This genus was founded upon a single species, *F. hirtus* Beauv., which, although commonly known under the name of *Hexagona hirta*, recalls the true honeycomb-like structure of the hymenium which was originally the distinguishing feature of the genus *Favolus*. The genera *Hexagona* and *Favolus*, both monotypic in origin, were interchanged by Fries because the species were unfamiliar to him and they have been incorrectly used ever since.

In the *Systema*, Fries followed Beauvois and included *Hexagona* under the subgenus *Favolus* of *Polyporus*. In the *Epicrisis*, Fries includes *F. hirtus*, Beauvois' type, in the genus *Hexagona* and follows it with *H. Mori*, Pollini's type. He then begins his genus *Favolus* with *F. europaeus*, a synonym of *H. Mori*.

The plants of this genus are not well known, few as they are. The two species ordinarily collected in North America are confined to the tropics, a comparatively unworked region. There is little difference either in the abundance or the distribution of these species, but they may be easily distinguished by color and markings. Both species vary rather remarkably in the size of their pores. Berkeley frequently commented upon it in his writings and his varieties testify to the fact. There appears to be absolutely no other different character accompanying this difference in pore measurement. A large collection of specimens is needed in order to guess at the cause of this variation, which at times amounts to two or three diameters.

Synopsis of the North American species

Surface marked with white and light-brown zones.	1. *F. tenuis*.
Surface variegated with dark-brown and purple zones.	2. *F. variegata*.

1. **Favolus tenuis** (Hook.)

Boletus reticulatus Hook. in Kunth, Synopsis **1**: (9). 1822. Not *B. reticulatus* Schaeff.

Boletus tenuis Hook. in Kunth, Synopsis **1**: (10). 1822.

Polyporus polygrammus Mont. Ann. Sci. Nat. II. Bot. **8**: 365. 1837.

Hexagona tenuis Fr. Epicr. 498. 1838.

Hexagona polygramma Fr. Epicr. 497. 1838. — Mont. Pl. Cell. Cuba 379. *pl. 14. f. 3.* 1842.

Hexagona favoloides Peck, Bull. Torrey Club **10**: 73. 1883.

This species is found in the Linnaean herbarium marked *Boletus favus*, but not by Linnaeus nor with his sanction. It was first described by Hooker from plants collected in the Andes between Popayan and Almaguer by Humboldt, under the name of *Boletus reticulatus.* Following this species on the next page is *Boletus tenuis*, described as differing from the preceding in its paler, smooth, dimidiate pileus and empty pores. According to Klotzsch, *Boletus reticulatus* is only a monstrous form of *Boletus tenuis* with the pores spongy-stuffed and the pileus orbicular, fixed at the center and more than usually reticulate-rugose on the surface. This view is strengthened by the fact, which Hooker states, that the two species were found growing together.

In reviewing Klotzsch's work in 1839, Berkeley lists *Boletus reticulatus* as synonymous with *Boletus tenuis* and enlarges Hooker's description from the original specimens, explaining that the monstrous form in question was caused by the accidental reversal of the log or branch upon which it grew and that the spongy-stuffed pores were due to the beginning of a new pileus, while the abnormal reticulations on the surface were caused by a new hymenium beginning to form on the old pileus. This leaves practically no doubt as to the identity of the two species; but since the first name is antedated by one of Schaeffer's, *Boletus tenuis* would hold for our plants in spite of the doubt.

The Cuban plant, finely described and figured by Montagne, appears in the figure to have larger pores than plants from elsewhere, but the type collections do not indicate that it is specifically different.

Peck's species, described from plants collected by J. J. Brown on the Roatan Islands off the coast of Honduras, is well represented by a number of specimens collected recently in Honduras by Wilson, and I do not find it distinct in its mature stages from Hooker's plant. The fresh young sporophores have a strong resemblance, as Peck says, to forms of *Agaricus confragosus.*

This species is fairly common and, in some localities, rather abundant in tropical America. Among the plants examined the following may be mentioned: Guayaquil, *Lagerheim;* Colombia, *Baker;* Nicaragua, *C. L. Smith, Shimek;* Honduras, *Wilson 4, 410, 449;* Mexico, *C. L. Smith;* Cuba, *Wright 315, Wilson.*

2. **Favolus variegatus** (Berk.)

Hexagona variegata Berk. Ann. Mag. Nat. Hist. II. **9**: 196. 1852. Proc. Amer. Acad. Arts & Sci. **4**: 122. 1858.

This species was first described from plants collected in San Domingo, as follows:

"Pileo tenui coriaceo dimidiato rugoso crebri-zonato multicolori velutino; hymenio umbrino poris mediis."

It is a very showy plant and rarely escapes the collector, being large and much expanded, with surface brilliantly marked with variegated zones of red and brown tints. The typical form occurs in southern Florida and the West Indies in fair quantity, while it ranges either in this form or in one with smaller pores, called var. *membranacea* at Kew, to various parts of Central America and into South America. The well-known tendency of species in this genus to vary in pore measurement prevents me from founding a species on the variety just mentioned. Possibly when more is known of the plants in the field, such a separation may be found desirable.

Specimens are at hand from Florida, *Calkins, Small & Nash, Small & Carter;* Costa Rica, *Endres;* Nicaragua, *Wright, C. L. Smith;* Mexico, *Egeling;* Colombia, *Baker;* Brazil, *Glaziou, Balanza;* Peru, *Pearce;* Bolivia, *Bang.*

SPECIES INQUIRENDAE

Hexagona papyracea Berk. Ann. Mag. Nat. Hist. **10**: Suppl. 379. 1843. Described from some unknown locality; possibly from

Brazil. The pileus is said to be nine inches broad, five inches long and as thin as paper, resembling most a species gathered by Schomburgk in Brazil communicated by Berkeley to Montagne under the name of *Hexagona variegata*, but considered by him only a non-setose state of his *Hexagona aculeata*.

A specimen in the herbarium of the Agricultural Department at Washington, collected by Wright in Nicaragua and labeled *Hexagona papyracea* Berk., differs from plants ordinarily called *Hexagona variegata* in its thinner, flexible pileus and smaller, stag-colored pores. There is such a specimen also in the herbarium of the New York Botanical Garden collected in the Peruvian Andes by Pearce and marked *Hexagona variegata* Berk. Both of these specimens, however, are only var. *membranacea* of *Hexagona variegata*, as type plants at Kew show.

Hexagona cingulata Lév. Ann. Sci. Nat. III. Bot. **2**: 200. 1844. Described from material collected in Hispaniola as follows:

"Pileo coriaceo reniformi membranaceo nudo zonato pallide cinereo nitente, alveolis mediis fuscis e rotundo hexagonis intus cinereis."

"Petite espèce réniforme, nue, zonée, de couleur pâle cendrée, et brillante, large de 2 à 4 centimètres; ses alvéoles sont parfaitement régulières, de moyenne grandeur, fauves, obtuses à la marge, et cendrées a l'intérieur."

From the above description this species can hardly be different from *Favolus tenuis* (Hook.).

Hexagona leprosa Fr. Nov. Symb. 101. 1851. Described as follows:

"Pileo suberoso crasso pulvinato laevigato leproso-pruinoso umbrino, alveolis profundis amplis acutis fusco-umbrinis, intus nudis."

"In Insula San Jan, Indiae occidentalis. Oersted."

Plants of this name at Kew are very distinct from other North American species, being much thicker and having much longer tubes, reminding one somewhat of a wasp's nest. Further study is necessary before their exact relations are known.

Hexagona unicolor Fr. Nov. Symb. 101. 1851. Described from "America calidiori" as follows:

"*H. unicolor*, dilute ferruginea, pileo coriaceo rigido subflexili applanato concentrice sulcato glabro, alveolis mediis vadosis angulatis."

The following notes are appended to the description:

"Pileus dimidiatus, sessilis, peltato-adnatus, reniformis, 2 unc. circiter transversim latus, passim plures imbricati, dilute ferrugineus, non priorum instar incrassatus, sed tenuis applanatus subflexilis, rigescens tamen, sulcis concentricis concoloribus exaratus (nec a basi radiato-rugosus), glaber. Margo acutus, passim incisus, concolor. Contextus floccosus, dilute ferrugineus. Pori medii, regulares, 4–6-goni, obtusiusculi, dilute cinnamomei.—Inter fungos Americanos inveni, sed locum specialem ignoro."

The type of the species I have not seen, but the description indicates that it is not far from *Favolus tenuis* (Hook.). This opinion is strengthened by comparing *Hexagona fasciata* Berk., which Fries says is very near his *Hexagona unicolor.*

Certain resupinate forms, such as *Hexagona carbonaria* B. & C. (Grevillea **1**: 68. 1872), *Hexagona pallens* Sacc. (Misc. Myc. **2**: 14. 1884) and *Hexagona vittata* Ell. & Macbride (Bull. Iowa Lab. Nat. Hist. **4**: 68. 1896), described from South Carolina, Mexico and Nicaragua respectively, hardly come within the scope of the present paper.

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STUDIES ON THE ROCKY MOUNTAIN FLORA—XIV

By PER AXEL RYDBERG

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Studies on the Rocky Mountain flora — XIV

PER AXEL RYDBERG

Machaeranthera Fremontii sp. nov.

Biennial with thick taproot; stems several, glandular-hispid and somewhat puberulent, 4–5 dm. high, branched; basal leaves oblanceolate, petioled, glandular-hispid and scabrous, sharply dentate; upper leaves sessile, linear or lanceolate; heads over 1 cm. high; bracts linear-lanceolate, cinereous, acuminate, well imbricated; herbaceous tip short, lanceolate, only slightly squarrose; rays purple, 8–10 mm. long; achenes densely strigose; pappus brownish or reddish.

It grows in black soil of river bottoms.

COLORADO: "Platte Waters," 1844, *Fremont 421* (type in herb. Columbia Univ.).

Machaeranthera Selbyi sp. nov.

Biennial; stem reddish, branched above, glabrous below, puberulent or minutely strigose above, only slightly glandular in the inflorescence; lower leaves linear-oblanceolate to oblanceolate, petioled, glabrous or rarely slightly puberulent, dentate and ciliate on the margin; upper leaves linear; inflorescence branched and open; heads about 1 cm. high; bracts in many series, well imbricated; glandular green tips small, lanceolate, strongly reflexed-squarrose; achenes minutely strigose.

This is perhaps nearest related to *M. spectabilis*, but that species has entire leaves and longer green tips to the bracts. It is also related to *M. glabrella* and *M. ramosa*, from which species it differs in the reflexed-squarrose bracts.

COLORADO: Ouray, 1901, *Underwood & Selby 93a* (type), *204*, *204s*, *201* and *202*.

Machaeranthera viscosula sp. nov.

Biennial with a rosette of basal leaves; stems few, about 2 dm. high, viscid-puberulent; basal leaves oblanceolate, petioled, the upper similar or linear, but sessile; all saliently and coarsely toothed; inflorescence narrow and racemiform, very viscid; heads about 1 cm. high; bracts linear, with a long linear-subulate spreading or reflexed green and very glandular tip, usually longer than the chartaceous lower portion; rays reddish-purple, 8–10 mm. long and fully 1 mm. wide; achenes sparingly strigose; pappus tawny.

This is closely related to *M. viscosa*, but differs in the lower stature, the racemiform inflorescence and the narrow saliently toothed basal leaves.

COLORADO: Veta Pass, 1896, *Shear 3655;* South Park, southeast of Jefferson, 1896, *Cowen 3222.*

Xylorrhiza Brandegei sp. nov.

Perennial with a cespitose caudex, canescent throughout, almost 1 dm. high; leaves spatulate or the upper oblanceolate, 3–4 cm. long, firm, closely and sharply serrate with bristle-tipped teeth; disk about 3 cm. wide; bracts narrowly linear-lanceolate, attenuate; achenes oblong, densely grayish-strigose, pappus tawny; rays rose-purple, 15–20 mm. long.

Closely related to **X. coloradensis** (*Aster coloradensis* Gray), but differs in the larger size, longer rays and scarcely spinescent bracts. It grows at an altitude of 3000 m.

COLORADO: San Juan Pass, 1875, *Brandegee* (type in the Gray herbarium).

Erigeron nematophyllus sp. nov.

Depressed cespitose-pulvinate perennial; flowering stems several, strigose, about 5 cm. high, few-leaved; both basal and cauline leaves linear-filiform, 2–4 cm. long, less than 1 mm. wide, strigose; heads solitary, 4–5 mm. high; bracts linear in 1–2 series, scarcely at all imbricated, acute, hirsute-strigose; rays pinkish or white, 4–5 mm. long and 1 mm. wide; achenes sparingly hirsute.

This is closely related to *E. radicatus*, but differs in the very narrow and erect leaves. It grows on rocky hills.

COLORADO: Dale Creek, 1897, *Osterhout* (type).

WYOMING: Fort Steele, 1901, *Tweedy 4103;* Sand Creek, 1900, *Aven Nelson 6993.*

Erigeron salicinus sp. nov.

Perennial with a slender rootstock; stem simple, 4–7 dm. high, glabrous or minutely and sparingly strigulose above; lower leaves petioled, about 1 dm. long; blades oblanceolate, dark bluish-green, glabrous except the minutely ciliolate entire margins, more or less distinctly 3-nerved; upper leaves linear or linear-lanceolate, sessile and half-clasping; inflorescence corymbiform, leafy; heads 7–8 mm. high; bracts linear-subulate, acuminate, glandular-puberulent, not at all hirsute, in 2 series but almost equal and crowded; disk 12–15 mm. wide; rays very numerous, fully 1 cm. long and less than 1 mm. wide, purple.

This is perhaps nearest related to *E. macranthus*, differing in the bluish-green narrow leaves, which are minutely ciliolate on the margin instead of hirsute-ciliate, and in the smaller heads.

COLORADO: Pagosa Springs, 1899, *Baker 670.*

Erigeron Vreelandii sp. nov.

Perennial with a rootstock; stem 6–7 dm. high, simple, sparingly pubescent and puberulent; lower leaves petioled, their blades oblanceolate; the rest sessile, lanceolate, somewhat clasping, entire, glandular-puberulent on both sides; inflorescence leafy, corymbiform; heads fully 1 cm. high; bracts linear-subulate, hirsute and glandular-puberulent, in 2 series, almost equal; disk 15–18 mm. wide; rays fully 1 cm. long, less than 1 mm. wide, very numerous, dark-purple.

This is nearest related to *E. subtrinervis*, but the leaves are glandular-puberulent instead of hirsute. It grows in meadows at an altitude of about 2300 m.

COLORADO: Wahatoya Creek, 1900, *Rydberg & Vreeland 5414.*

Erigeron Smithii sp. nov.

Perennial with a rootstock; stem simple, glabrous below, glandular-puberulent above; basal leaves 6–10 cm. long, petioled; blades oblanceolate or spatulate, glabrous, ciliate on the entire margins; upper stem-leaves lanceolate, sessile, more or less clasping and often reduced; heads 1–5, on long almost erect branches, about 6 mm. high; bracts linear-subulate, acuminate, glandular-puberulent, in two equal series; rays purple, 10–12 mm. long, 1 mm. wide; achenes strigose; pappus double, the outer of very short bristles.

This is closely related to *E. glabellus*, but is more glabrous, and has glandular-puberulent, not hirsute, bracts. It grows in rich meadows at an altitude of 2100–3000 m.

COLORADO: Parlin, Gunnison Co., 1901, *B. H. Smith 118* (type); Gunnison, 1901, *Baker 558;* Antonito, 1898, *Earle 42;* Sargent, 1896, *Clements 127;* Villa Grove, 1896, *Clements 123;* Leadville, 1901, *Underwood & Selby 494*.

Erigeron Earlei sp. nov.

Perennial; stems several, simple, 3–4 dm. high, strigose; basal leaves 5–6 cm. long, narrowly oblanceolate, strigose on both sides, often callous-denticulate; stem-leaves linear and sessile, and reduced; heads about 3, 6 mm. high; bracts linear-subulate, acuminate, in about 2 series, nearly equal, densely strigose; rays numerous and very narrow, white, about 8 mm. long.

This is related to *E. glabellus*, but differs from all its relatives by the appressed, dense, strigose pubescence.

COLORADO: Antonito, 1898, *Earle*.

Erigeron Peasei sp. nov.

Depressed cestipose perennial; stem 5–8 cm. high, scapiform or with 1–2 leaves, appressed-pubescent; basal leaves about 2 cm. long, petioled, their blades oblanceolate, acute, strigose; stem-leaves linear, sessile; heads solitary, 6–7 mm. high; bracts linear-subulate, scarcely at all imbricated, acuminate, sparingly hirsute; disk about 1 cm. wide; rays numerous, about 7 mm. long and 1 mm. wide.

This is nearly related to *E. radicatus*, but differs in the appressed pubescence and broader leaves.

COLORADO: Lake City, 1878, *H. N. Pease* (type in herb. Columbia Univ.).

Erigeron vetensis sp. nov.

Densely cespitose-puvinate perennial; stems 5–8 cm. high, hirsute, few-leaved; leaves linear or linear-oblanceolate, hirsute, 2–4 cm. long; heads solitary, about 7 mm. high; bracts linear, acuminate, hirsute as well as slightly glandular-puberulent; rays purple, 8–10 mm. long, over 1 mm. wide; achenes strigose; pappus more or less double.

In dry places on high mountains of southern Colorado at an altitude of 2400–3000 m. It is intermediate between *E. radicatus* and *E. glandulosus*, resembling the former most in pubescence, and the latter in habit.

COLORADO: Mountains near Veta Pass, 1900, *Rydberg & Vreeland 5427* (type); Veta Mountain and Ojo, *5421, 5422;* West Spanish Peak, *5424*.

Antennaria Sierrae-Blancae sp. nov.

Depressed perennial, pulvinate-cespitose, rosulate, almost stemless; leaves broadly spatulate, less than 1 cm. long, abruptly acute, white-floccose beneath, glabrate above; heads subsessile in the rosettes, 6–7 mm. in diameter; bracts broadly oblong to almost obovate, with a scarious brown upper portion.

Closely resembling *A. rosulata* in habit, it differs however in the smaller heads, brown bracts and leaves that are glabrate above. It grows at an altitude of 3600–4000 m.

COLORADO: Sierra Blanca, 1877, *Hooker & Gray* (type in Gray herbarium).

Helianthus aridus sp. nov.

Annual; stem 3–8 dm. high, more or less hispid; leaves all petioled, the lower opposite, the upper usually alternate; blades lanceolate, 4–7 cm. long, entire or crenate, acute, hispid-scabrous on both sides; heads rather few; bracts ovate, abruptly acuminate, hispid on the back and hispid-ciliate on the margins; disk 1.5–2 cm. wide, purplish; rays oblong to oval, 15–20 mm. long, 6–8 mm. wide; achenes cuneate, almost black, finely strigose, about 5 mm. long and 2 mm. wide.

This species has been mistaken for *H. petiolaris*, which it resembles most, but the bracts are hispid-ciliate and strongly acuminate in the manner of *H. lenticularis*. *H. aridus* grows in dry ground, especially in old fields and waste places.

MONTANA: Great Falls, 1885, *F. W. Anderson* (type); Polson, 1901, *Umbach 261*.

WYOMING: Gros Ventre Mountains, 1900, *C. C. Curtis*.

COLORADO: Manitou, 1901, *Clements 8* (mixed with *H. petiolaris*).

NEBRASKA: Kimball, 1891, *Rydberg 184*.

Tetraneuris Crandallii sp. nov.

Cespitose, acaulescent perennial; leaves narrowly linear-oblanceolate, conspicuously white-woolly at the base, 4–6 cm. long, 2–3 mm. wide, sparingly long-hairy, soon glabrate; scape 1–3 dm. long, sparingly strigose; involucre hemispherical; bracts about 8 mm. long, linear-oblong, silky-villous, but hairs rather appressed; rays about 15 mm. long, 5–8 mm. wide, 3-lobed, 4–5-nerved.

This species is related to *T. arizonica* and *T. pilosa*, but differs from the first in the narrow glabrate leaves, and from the latter in the narrow bracts and larger rays.

COLORADO: Grand Junction, 1894, *Crandall* (type); McCoy's, Eagle County, *Osterhout 2757*.

Tetraneuris angustifolia sp. nov.

Cespitose, acaulescent perennial; leaves narrowly linear-oblanceolate, 4–10 cm. long, 4–5 mm. wide, loosely and sparingly long-villous or glabrate in age, not densely villous at the base; scape 2–3 dm. high, strigose; involucre hemispherical; bracts oblong, obtuse, densely villous; disk 10–12 mm. wide; rays about 1 cm. long and 4 mm. wide, 3-toothed and conspicuously 4-nerved.

This species is nearest related to *T. scaposa*, from which it differs in the narrow leaves. It has therefore been mistaken for *T. linearis;* but in that species the branches of the caudex are rather slender and elongated and the leaves are narrowly linear, 1–2 mm. wide. *T. angustifolia* grows on rocky hills up to an altitude of 2000 m.

NEW MEXICO: White Mountains, 1897, *Wooton 374* (type).

COLORADO: Fort Lyon, 1863, *Palmer*.

TEXAS: Kerrville, 1894, *Heller 1614;* Great Cañon of Mt. Carmel, 1852, *Parry* (Mex. Bound.) *638;* Belknap, 1858, *Hayes;* Rock Creek and Limpia, 1852, *Bigelow* (Mex. Bound); Rio Bravo del Norte, between San Pedro and Puercos, 1852, *Schott*.

Artemisia dracunculoides Wolfii var. nov.

Stout, usually with broader leaf-segments or leaves; heads larger, 3–5.5 mm. in diameter; outer bracts longer, lanceolate or linear-oblong, mostly acutish, nearly equaling the inner (in *A. dracunculoides* oblong, obtuse, about half as long as the inner).

COLORADO: Twin Lakes, 1873, *Wolf 530* (type); Hamor's Lake, north of Durango, 1898, *Baker, Earle & Tracy 628;* Grizzly Creek, 1896, *Baker*.

NEW MEXICO: Chama, 1899, *Baker 631*.

Artemisia saxicola nom. nov.

Artemisia Chamissoniana saxatilis Besser; Hook. Fl. Bor. Am. **1**: 324. 1833. Not *A. saxatilis* Waldst.

A. norvegica A. Gray. Syn. Fl. **1**^{2}: 371. 1884. Not *A. norvegica* Fries.

The American plant differs from the North European in having more numerous smaller heads on shorter peduncles, more hairy leaves, lanceolate in outline, and taller stem. In the true *A. norvegica* the basal leaf-blades are as broad as long and have usually only 5 principal divisions.

Artemisia Brittonii sp. nov.

Perennial with a horizontal rootstock; stem rather stout, 3–6 dm. high, white-floccose; lower leaves cuneate or oblong-oblanceolate, 3–5-lobed mostly above the middle, densely white-tomentose on both sides, the lobes lanceolate; upper leaves ovate-lanceolate, entire; inflorescence paniculate; panicles narrow and heads conglomerate, 3–4 mm. high, about 2 mm. broad; bracts ovate and densely floccose; flowers about 15, heterogamous, light-brown or yellow; achenes and receptacle glabrous.

This is related to *A. ludoviciana* Nutt., but differing in the stouter habit, more crowded inflorescence, and principally in the leaves, which are equally tomentose on both sides.

COLORADO: Golden, 1882, *N. L. Britton* (type, in herb. Columbia College); Boulder, 1891, *Penard 285;* also 1902, *Tweedy 4906.*

UTAH: Green River, 1850, *Stansbury;* Salt Lake Valley, *Lauderdale;* Salt Lake City, 1884, *Harry Edwards.*

Artemisia Underwoodii sp. nov.

Perennial, with a horizontal much-branched rootstock; stems slender, 2–6 dm. high. somewhat floccose, usually simple up to the inflorescence; leaves 3–5 cm. long, pinnately parted, with 3–7 (usually 5) linear or linear-lanceolate acute lobes, densely white-floccose beneath, green and slightly tomentose above at first, but in age glabrate; inflorescence paniculate, but panicle narrow and the small heads crowded; heads campanulate, scarcely over 3 mm. high and 2.5 mm. broad; bracts ovate, tomentose, slightly scarious on the margin; flowers 15–20, heterogamous, brown; achenes and receptacle glabrous.

This is nearest related to *A. ludoviciana*, but differs in the deeply parted leaves and their narrow lobes. It grows on chaparral-covered hills and mountain-sides at an altitude of 2300–2700 m.

COLORADO: Ouray, 1901, *Underwood & Selby 74* (type) and *34;* Georgetown, 1895, *Rydberg.*

Artemisia pudica sp. nov.

Perennial with a horizontal rootstock; stem 4–6 dm. high, simple up to the inflorescence, white-floccose; leaves linear or narrowly linear-lanceolate, 6–10 cm. long, 6–8 mm. wide, entire, white-floccose on both sides; inflorescence a narrow panicle, the branches long and nearly erect, racemiform; heads nodding on short peduncles, campanulate, about 5 mm. high and 4 mm. broad; bracts ovate, densely tomentose, with a darker midrib and slightly scarious margin; flowers about 20, heterogamous, yellow; receptacle and achenes glabrous.

This species is related to *A. gnaplalodes*, but is characterized by the racemiform branches of the inflorescence with peduncled, nodding heads. It grows at an altitude of about 2300 m.

COLORADO: Gunnison, 1901, *Baker 573*.

Pyrrocoma lagopus sp. nov.

Perennial with a taproot; stems decumbent, 1–2 dm. long, more or less villous, especially at the base and the nodes; basal leaves petioled, 6–10 cm. long; blades lanceolate or linear-lanceolate, firm, distantly serrate with almost spinulose teeth; stem-leaves narrowly linear-lanceolate, sessile, with partly clasping bases; inflorescence racemiform; involucre 8–9 mm. high, more or less villous, especially at the base; bracts imbricated in about 3 series, oblong, acute, green on the back, yellowish on the sides and base; disk about 12 cm. wide; rays about 8 mm. long and over 1 mm. wide; achenes hirsute-strigose.

This species is nearest related to *P. Vaseyi*, but differs in the villous stem and involucre. In habit it also reminds one of *P. uniflora* and *P. inuloides*, but in these species the bracts are nearly in a single equal series. *P. lagopus* grows on dry plains and in saline flats.

WYOMING: Hams Fork and La Barge, 1900, *C. C. Curtis* (type).

COLORADO: North Park, 1899 (collector not given, but plants distributed from Herb. State Agr. Coll., under no. *3232*).

Tetradymia linearis sp. nov.

A low, unarmed shrub; bark of the older stems shining and flaky, that of the young branches more or less white tomentulose; leaves linear, white-tomentose, somewhat keeled, more or less arcuate-squarrose and pungent-pointed; bracts of the involucre usually 4, oblong, acute, white-tomentose, about 8 mm. long; flowers about 4; lobes of the corolla linear, about 3 mm. long; pappus very copious, yellowish; bristles scabrous; achenes hirsute-villous.

This species grows on dry hills and tablelands up to an altitude of 2300 m. It is nearest related to *T. inermis* Nutt., but is distinguished by the narrow, more or less squarrose, and pungent leaves.

Utah: Rock Creek, 1877, *Palmer 264* (type, in herb. Columbia University).

Colorado: Gunnison, 1901, *Baker 833*.

Arnica coloradensis sp. nov.

Perennial, about 2 dm. high and with about 3 pairs of leaves; stem villous; basal leaves obovate, nearly sessile, sparingly pubescent, 4–5 cm. long; stem-leaves sessile, ovate or ovate-lanceolate, 5-nerved; heads often solitary or few; involucre hemispherical; bracts broadly oblanceolate, acute or acuminate, often tinged with purple, sparingly villous and somewhat glandular, 8–9 mm. long; rays bright-yellow, over 1 cm. long and 5 mm. wide; achenes finely strigose.

This species is perhaps nearest related to *A. subplumosa*, but differs in the low habit, the single or few heads, and the broad involucral bracts.

Colorado: 1872, *Parry* (in herb. Columbia University).

Carduus Osterhoutii sp. nov.

Stout; stem round-angled and striate, more or less tinged with purple, more or less arachnoid-hairy; leaves pinnately parted about halfway to the midrib, glabrate above, white-tomentose beneath; lobes at least of the larger leaves oblong, obtuse with a weak spine; heads 2.5–3 cm. high and about 2 cm. broad; bracts arachnoid-hairy, linear-lanceolate, without glandular dorsal ridge, gradually tapering into an almost erect, stout, flat spine; pappus scabrous.

This is nearest related to *C. Hookerianus* and *C. oreophilus*, but differs from both in the oblong, obtuse lobes of the larger leaves and the long, stout, flat spines of the involucre.

Colorado: Red Cliff, Eagle Co., 1902, *Osterhout 2706* (type); Tennessee Pass, *2640*.

Carduus perplexans sp. nov.

Rather slender, about 5 dm. high; stem striate, purplish, slightly tomentose; lower leaves oblanceolate, the upper lanceolate and clasping, all merely toothed, with weak yellowish spines, glabrous and somewhat glaucous above, rather thinly white-tomentose beneath; heads about 3 cm. high and broad; bracts well imbricated, usually with a glandular back, the outer shorter and tipped with a short weak spine, the inner tipped with a dilated, deltoid, erose appendage; corolla rose or red-purple.

The appendages of the bracts would place this species nearest *C. Centaureae*, but the bracts are broader and have a distinct glandular back, the corolla is pink or purplish, and the whole plant suggests *C. altissimus* and its relatives. In fact the species combines characters of the *Carlinoides* and the *Altissimus* groups. It grows at an altitude of nearly 2100 m.

COLORADO: Cimarron, 1901, *Baker 286*.

Carduus coloradensis sp. nov.

Cnicus Drummondii A. Gray Syn. Fl. **1**^{2}: 402, in part, *i. e.*, as to the Colorado specimens.

Rather stout, simple, 3–5 dm. high; stem striate, sparingly arachnoid; leaves 1.5–2 dm. long, 4–7 cm. wide, linear or oblong in outline, pinnately lobed about half-way to the midrib, sparingly arachnoid above, more or less white-tomentose beneath; lobes ovate, tipped with yellowish spines 2–5 mm. long and bordered with smaller spines; heads 3–4 cm. high and about as broad; bracts glabrous or nearly so, firm, more or less yellowish, without dorsal glandular ridge, well imbricated in many unequal series; the outer with weak spines; the inner unarmed and with slightly dilated crisp tips; corolla white or slightly pinkish.

This species has gone under the name of *C. Drummondii*, but the latter has larger heads often 5 cm. high and broad, broader and thin flat brownish or greenish bracts, broader erose appendages, red-purple corolla, and the leaves more deeply dissected, more arachnoid and scarcely at all tomentose. In reality *C. coloradensis* is more closely related to *C. scariosus*, from which it differs mainly in the less deeply dissected leaves and broader segments.

COLORADO: Pagosa Springs, 1899, *Baker 644* (type); Gunnison, 1901, *Baker 592;* Wolcott, 1902, *Osterhout 2651*.

Carduus floccosus sp. nov.

Stout, about 1 m. high; stem angled, loosely floccose; leaves oblanceolate in outline, about 2 dm. long, loosely floccose on both sides, divided two-thirds to the midrib; lobes 2-cleft, each division lanceolate, 1.5-2 cm. long, tipped with a spine about 5 mm. long; heads about 3 cm. high, 1.5–2.5 cm. wide; bracts slightly floccose on the margin and with a very narrow glandular dorsal line; the outer lanceolate, the inner linear-lanceolate, all with a short and weak spine; corolla red-purple.

This species belongs to the *C. undulatus* group and has been mistaken for that species. It has almost the same kind of leaves, although more loosely floccose; but the heads are very different, resembling more those of *C. Flodmanii* and *C. altissimus*, the bracts having a very slender glandular dorsal line.

COLORADO: Wolcott, 1902, *Osterhout 2652.*

Carduus Tracyi sp. nov.

Simple below; stem 3–7 dm. high, striate and loosely floccose; leaves oblanceolate in outline, divided to near the base, green but slightly floccose above, more or less tomentose beneath; lobes oblong to linear-lanceolate, tipped with yellow spines 5–8 mm. long; heads 3–3.5 cm. high and about 3 cm. or less wide; bracts slightly floccose when young, yellowish with a very broad and dark glandular spot on the back, the outermost and inner narrowly lanceolate, the middle ovate-lanceolate, all with a short spreading spine; corolla ochroleucous.

This is nearest related to *C. Nelsonii* Pammel, but is less tomentose, has smaller heads, more acute leaf-segments, and broader bracts with shorter, more slender and spreading spines. It grows in dry fields at an altitude of about 2100 m.

COLORADO: Mancos, 1898, *Baker, Earle & Tracy 90* (type); Green Mountain Falls, 1895, *E. A. Bessey.*

Gaertneria linearis sp. nov.

Perennial, shrubby at base; stems about 2 dm. high, sparingly hirsute, branched; leaves once or twice pinnate, 3–4 cm. long, strigose above, minutely tomentulose beneath; lobes linear, obtuse, 3–5 mm. long; staminate racemes about 3 cm. long; heads nodding, 3–4 mm. wide; involucre strigose, cleft scarcely halfways into rounded-ovate lobes; pistillate involucre with few slender spines.

This is perhaps nearest related to *G. tenuifolia*, but is shrubby at base; the leaves are smaller, finely tomentulose beneath and with linear obtuse (instead of oblong acute) divisions, of which the terminal is not conspicuously elongated. *G. linearis* grows at an altitude of 2100 m.

COLORADO: Calhan, 1893, *Saunders*.

Crepis tomentulosa sp. nov.

Scapose perennial, with a taproot; leaves basal, glabrous and glaucous, 1–1.5 dm. long, oblanceolate in outline, acute, sessile, dentate with sharp salient or reflexed teeth; scape 4–5 dm. high; stem-leaves, if any, linear-lanceolate, bract-like, entire; involucre turbinate, about 12 mm. high, as well as the upper part of the branches of the inflorescence tomentulose when young; bracts linear-lanceolate, acuminate, with dark backs, and with a few calyculate ones at their base; ligules bright-yellow, nearly 1 cm. long.

This species is nearest related to *C. glauca*, from which it differs principally in the tomentulose involucre and peduncles. It grows at an altitude of nearly 3000 m.

COLORADO: Ruxton Dell, near Pikes Peak, 1901, *Clements 342*.

Crepis petiolata sp. nov.

Perennial; stem with 1–3 leaves, glabrous and often purplish below, more or less glandular-hirsute above, especially the branches of the inflorescence; basal leaves long-petioled; blades oblanceolate or spatulate, usually obtuse, sinuate-dentate or entire, about 1 dm. long, glabrous and glaucous; stem-leaves oblanceolate and usually sessile; involucre about 12 mm. high, turbinate-campanulate, pubescent with glandular black hairs; bracts linear-lanceolate, acuminate; ligules about 12 mm. long and 3 mm. wide; achenes strongly ribbed; pappus white.

This species is related to *C. runcinata*, but the leaves are glabrous and long-petioled, and the stem-leaves are usually ample. It grows in the mountains at an altitude of 2000–2700 m.

COLORADO: Along Bear River, five miles east of Hayden, 1899, *Osterhout 21* (type); Georgetown, 1895, *Rydberg*.

WYOMING: Headwaters of Clear Creek and Crazy Woman River, 1900, *Tweedy 3088*.

Crepis perplexans sp. nov.

A scapose perennial; leaves about 1 dm. long, glaucous and glabrous or rarely with a few hairs on the midrib below and on the margin of the narrower base, oblanceolate, sessile or short-petioled, usually more or less runcinate-toothed; scape glabrous; involucres turbinate-campanulate, about 1 cm. high, more or less glandular-hairy with yellowish hairs and slightly tomentulose when young; bracts linear-lanceolate, acuminate; rays yellow, about 1 cm. long; achenes brown, strongly ribbed; pappus white.

This has been confused with *C. runcinata*, but that species has thinner hairy leaves, which are scarcely glaucous. *C. confusa* is really more closely related to *C. glauca*, from which it differs only in the pubescence of the involucre and the usually broader leaves. *C. confusa* grows in valleys from North Dakota and Alberta to Nebraska and Colorado. As the type may be regarded:

WYOMING: Encampment, Carbon Co., 1901, *Tweedy 4081.*

Crepis denticulata sp. nov.

Scapose perennial; leaves basal, obovate or more rarely obovate-oblanceolate, glabrous or nearly so, obtuse, less than 1 cm. long, denticulate or with a few lobes towards the base; scape 1–3 dm. high, glabrous up to the inflorescence; involucre turbinate, scarcely 1 cm. high, hirsute with glandular black hairs, as well as the branches of the inflorescence; ligules about 8 mm. long; achenes brown, strongly ribbed; pappus white.

This species is nearest related to *C. riparia*, but is a much smaller plant in every part and with glabrous leaves. It grows in the mountains.

COLORADO: Lake John, North Park, 1898, *Shear & Bessey 4004* (type).

WYOMING: Fort Bridger, 1873, *Porter.*

UTAH: 1875, *Parry 62;* Jordan Valley, 1869, *Watson 712.*

Crepis angustata sp. nov.

Crepis gracilis Rydb. Mem. N. Y. Bot. Gard. **1**: 461, in part. 1900. Not *C. occidentalis gracilis* D. C. Eaton.

Perennial, whole plant more or less canescent-puberulent and scabrous; stem 3–7 dm. high; basal leaves and lower stem-leaves petioled, runcinate; main body narrowly linear-lanceolate, acuminate; lobes linear or linear-lanceolate, usually curved forward; upper stem-leaves entire and sessile; involucre cylindric, about 1 cm. high and 5 mm. broad; bracts 5–7, linear-lanceolate, acute, canescent but not glandular, with a few minute calyculate ones below; flowers 5–10.

This species has been taken for *C. gracilis*, or *C. intermedia gracilis*, under which name it is more commonly known, but the latter has much narrower leaves, the main portion not being wider than the long lobes. *C. intermedia*, to which it is more closely related, has much broader main portion of the leaves, and the lobes are lanceolate and usually directed downward. *C. angustata* grow on hillsides from Montana and Washington to Colorado and Oregon.

COLORADO: North Park, 1896, *Baker* (type).

Agoseris maculata sp. nov.

Leaves oblanceolate, more or less pubescent, especially on the margins and veins; scape 1–2 dm. high, often sparingly hairy and villous under the head; involucre campanulate, about 2 cm. high; outer bracts ovate or ovate-lanceolate, more or less villous especially on the margins, dotted with blackish dots; inner bracts lanceolate; ligules yellow or the outer tinged with reddish; achenes with a short striate beak.

This is somewhat related to *A. villosa*, but differs in the broad acuminate outer bracts. It grows in the mountains of Colorado at an altitude of 3000–3900 m.

COLORADO: Silver Plume, 1895, *Shear 4605* (type); Tennessee Pass, 1902, *Osterhout 2643*.

Agoseris attenuata sp. nov.

Leaves narrowly oblanceolate, 1–1.5 dm. long, glabrous and glaucous, usually denticulate, tapering into a short petiole; scape about 1.5 dm. high, villous near the head; involucre campanulate, about 2 cm. high; outer bracts lanceolate, somewhat villous on the margins, purplish on the back; inner bracts linear-lanceolate long-attenuate, equaling the pappus; achenes light-brown, with thick ribs, contracted above into a short striate beak.

This is related to *A. pumila* and *A. glauca*, but differs from the former in the smaller heads and narrower leaves, from the latter in the more or less villous involucre, and from both in the elongated inner bracts. It grows at an altitude of nearly 3000 m.

COLORADO: Mountain west of North Park, 1900, *Osterhout 2248*.

Agoseris roseata sp. nov.

Leaves about 2 dm. long, long-petioled; blades oblanceolate, acute, denticulate or entire, glabrous and glaucous; scape 5–6 dm.

high, slightly villous above; involucre campanulate, 1.5–2 cm. high; bracts oblong-ovate, acute, nearly glabrous, often with a rose-colored spot in the middle; corolla rose-colored; achenes about 1 cm. long, as well as the short beak strongly striate.

In habit and flowers this resembles most *A. aurantiaca*, but is glabrous and glaucous, and the achene with its short beak places it in the *A. glauca* group.

COLORADO: Bear River, 20 miles below Steamboat Springs, 1899, *Osterhout.*

Agoseris humilis sp. nov.

Leaves spreading or ascending, oblanceolate or linear-oblanceolate, 6–10 cm. long, entire or denticulate, glabrous or slightly hairy on the short petioles; scape 1–1.5 (seldom 2) cm. high, slightly villous below the head; involucre 1.5–2 cm. high; bracts linear-lanceolate, slightly villous-ciliate; corolla rose-purple, or at first orange; achenes 12–15 mm. long, with a long, scarcely striate beak.

This is closely related to *A. gracilens*, but differs in the low habit, small heads and more spreading leaves. It grows at an altitude of about 2700 m.

COLORADO: Ironton Park, 1901, *Underwood & Selby 308* (type); Tennessee Pass, 1902, *Osterhout 2710.*

Agoseris rostrata sp. nov.

Leaves narrowly linear-lanceolate, about 2 dm. long, usually more or less laciniate with linear lobes, glabrous and glaucous; scape 2–6 dm. high, more or less villous, especially under the head; involucre fully 3 cm. high; outer bracts oblong or ovate, obtuse, glabrous, about half as long as the elongated linear or linear-lanceolate inner ones; corolla orange or purple; achenes fully 2 cm. long, with a very long and slender, not striate, beak.

In habit this most resembles *A. elata*, but the bracts and the achenes associate it with *A. grandiflora.*

COLORADO: Lower Boulder Cañon, 1901, *Osterhout 2478* (type); between Sunshine and Ward, 1902, *Tweedy 4895.*

Taraxacum leiospermum sp. nov.

Leaves spreading, oblanceolate, less than 1 dm. long, dark-green, obtuse or acutish, retrorse-dentate, rarely lobed; scape about 1 dm. high, slightly villous when young; outer bracts 7–10 mm. long, lanceolate with spreading tips; inner linear, about twice as long; neither corniculate; achenes greenish, ribbed, tuberculate above, but otherwise smooth.

Probably related to *T. augustifolium* Greene, but that is described as having much narrower leaves and erect outer bracts. It differs from *T. montanum* in the longer, narrower and spreading bracts and the less lobed leaves.

COLORADO: Tennessee Pass, 1902, *Osterhout 2645* (type); Seven Lakes, 1896, *E. A. Bessey*.

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PHYCOLOGICAL STUDIES—I.

NEW CHLOROPHYCEAE FROM FLORIDA AND THE BAHAMAS

By MARSHALL AVERY HOWE

NEW YORK
1905

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Phycological studies — I. New Chlorophyceae from Florida and the Bahamas

Marshall Avery Howe

(With plates 11–15)

Halimeda scabra sp. nov.

Usually dark green, fading to a yellowish green on drying, strongly calcified and commonly rough to the touch, erect or ascending and forming clusters 6–9 cm. high or sometimes reclinate among other algae and reaching a length of 25 cm. : branching mostly dichotomous, usually frequent or somewhat congested, rarely sparing : segments plane, enervate, discoid, subreniform, suborbicular, or occasionally deltoid-obovate, 4–14 mm. broad, 0.6–1.5 mm. thick, margin entire : peripheral utricles hexagonal in surface view, 27–50μ in diameter, varying from subturbinate to subfusiform in lateral view, 70–240μ long, galeate, $\frac{1}{6}$–$\frac{2}{5}$ of the length consisting of the acuminate, often indurated terminal cusp ; lateral walls in contact for only a small fraction of their length, easily separating on decalcification, usually somewhat thickened or gibbous at the angles of contact : filaments of the central strand fusing in twos or threes at the joints : sporangiophores 1.6–2.5 mm. long, rarely simple, mostly once or twice dichotomous, sometimes subracemose, irregularly proliferous, or in part cymose, fringing the margins of the segments or now and then scattered on the flattened faces, each commonly springing from the fusion of two central filaments ; the pyriform sporangia 0.16–0.32 mm. broad, for the most part alternately distichous on the ultimate branches. (Plates 11 and 12.)

Not uncommon on the coast of Florida and the outlying keys from Jupiter Inlet to Key West ; also in the Bahama Islands. It grows on a rocky bottom or about the bases of sponges, from low-tide mark down to a depth of at least three meters. The description has been drawn from a study of thirty or more specimens, representing about as many localities, but our fertile spceimen *no. 2905* from Sands Key, Florida (March 30, 1904), which has furnished material for figures 2 and 3 of plate 11 and for figures 1, 3, 5, 7–11 of plate 12, we consider the nomenclatorial type.

Halimeda scabra is similar to *Halimeda Tuna* in form and habit and it occurs under the latter name in various herbaria. It can, however, be easily distinguished by the always strongly galeate-cuspidate peripheral utricles, a character which, we believe, has thus far been observed in no other species of the genus. These spines or cusps are so large that they are visible under a good hand lens in a properly lighted profile view across a segment-margin even in a dried specimen. The plant is also more strongly calcified than *Halimeda Tuna*, and the peripheral utricles are smaller in surface view and separate more readily on being decalcified. However, *Halimeda scabra* bears a stronger resemblance in outward form to the typical Mediterranean *Halimeda Tuna* than it does to a second South Floridan and West Indian *Halimeda* of the *Tuna* alliance, with which it sometimes grows associated. This second *Halimeda* is larger, always smooth, only slightly calcified, of a bright light green color and lubricous when living and more or less papyraceous on drying. Its segments reach an extreme width, so far as observed, of 35 mm.; and in general, the plant may be said to combine characters of *Halimeda Tuna platydisca* (Decne.) Barton and *H. cuneata* Hering, as these two are limited and defined by Mrs. Gepp (Miss Ethel Sarel Barton) in her admirable monograph on "The Genus Halimeda." * The lateral walls of the peripheral utricles are in firm contact for $\frac{1}{5}$–$\frac{2}{3}$ their length, as in *H. cuneata*, but the peripheral utricles measure 45–120 μ in surface view, while those of *H. cuneata* are described by Mrs. Gepp as 25–40 μ; the filaments of the central strand separate readily at the joints as in *Halimeda Tuna* instead of being coherent as in *H. cuneata*.† This plant has been met with only in a sterile condition. It seems rather violent to identify it either with *Halimeda Tuna* or with *H. cuneata*, and it is possible that further acquaintance with it will show constant and reliable characters for distinguishing it from both. The *Halimeda scabra* and the smooth plant of the *Tuna-cuneata* alliance have been more or less mixed in certain American exsiccatae. Thus, in the *no. 41* of the Algae Exsicc. Am. Bor. of Farlow, Anderson and Eaton, issued as *Halimeda Tuna*, out of seven sets examined, three are *Halimeda scabra*, two are the smooth species, and two contain a mixture of the two species. In *no. 167* of the Phycotheca Boreali-Americana of Collins, Holden and Setchell, distributed as *Halimeda Tuna*, out of ten sets examined, eight are *Halimeda scabra*, one is the smooth *Halimeda*, and one is a mixture of the two. The plants from Jupiter Inlet distributed in Curtiss' Algae Floridanae as *Halimeda Tuna*, also include the two distinct species.

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* Siboga-Expeditie. Monographe LX. 1901.

† Mrs. Gepp alludes (*l.c.* p. 16, 17) to a specimen from Rangiroa brought by Professor Agassiz in the *Albatross*, which forms a connecting link between *H. Tuna* and *H. cuneata*, but this has the peripheral utricles of *H. Tuna* and the joint connections of *H. cuneata*.

The only specimens that we have seen from Atlantic waters approaching the American shores, which seem to agree thoroughly well with the typical *Halimeda Tuna*, are from Bermuda. These we have found also in a fertile condition.

The sporangiophores of *Halimeda scabra* show a good deal of variety in mode of branching, as will appear from the above diagnosis and from the accompanying figures. A comparison with the sporangiophores of *Halimeda Tuna* as figured and described by Derbès & Solier * and by Mrs. Gepp, † and as exhibited in the Bermudian specimens alluded to above, does not seem to bring out any very important or reliable differences. Possibly the sporangia in *H. scabra* are more regularly distichous. The regular *alternation* of the sporangia in *H. scabra* is often interfered with by the suppression of one or more sporangia or by the occurrence of a cluster of two or three where we would normally expect only one, but a real interruption of the *distichous* arrangement is rarely found, while in *H. Tuna* such interruption is perhaps of more frequent occurrence. It should be noted that in *Halimeda scabra* the stalk of the well-matured sporangium shows in most cases a distinct septum or plug, cutting off, more or less completely, the contents of the sporangium from the sporangiophore. This is variable in position, but is commonly near the base of the stalk and is often accompanied by a slight constriction. The plug, which seems to consist of a callose mucilage rather than cellulose, sometimes extends throughout the length of the stalk to the base of the sporangium, in the narrower sense of the word. It is often traversed by a central canal, yet in some cases the lumen appears entirely closed. Some apparently mature sporangia show no trace of a septum or plug, but in such instances similar plugs can usually be found in the rhachis of the sporangiophore and it is probable that these may serve as common septa for two or more sporangia. A basal septum or plug has not been attributed to the sporangium of *Halimeda*, so far as we know; in fact, its existence has been expressly denied,* yet from analogy with *Codium*† of the same family, and perhaps we may say from analogy with the known sporangia of the Siphonales in general, its presence is what would be expected. In the fertile specimen from Bermuda, which we believe referable to *Halimeda Tuna*, the material is less well preserved and less mature and the plugs are more difficult to demonstrate, yet we have observed in this also a few undoubted instances of their presence.

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* Suppl. Comptes Rendus hebdom. Séances Acad. Sci. 1: 46, 47. *pl. 11. f. 18–22: pl. 12. f.* 1–5. 1856.

† Journ. of Bot. 42: 193–197. *pl. 461.* Jl 1904.

We regret that the opportunity for seeing the living zoöspores of *Halimeda scabra* was not followed out. The material preserved with the aid of formaldehyde does not enable one to get a very good conception of the form and size of the zoöspores, but the protoplast of the sporangium often shows a minutely polygono-radial structure at its periphery.

Siphonocladus rigidus sp. nov.

Caespitose, subfastigiate, rigid, the cushions 2–5 cm. high, of a light translucent green when living: primary ramification mostly dichotomous or subdichotomous, the main axes often also with irregular or subsecund, lateral prolifications: filaments 350–1150 μ broad, consisting usually of a single series of cells,‡ but often, especially under the dichotomies, becoming two or three cells in width owing to longitudinal or oblique divisions: cells variable in length, mostly about as long as broad, those of prolifications sometimes 10–20 times as long; wall of filament conspicuously lamellate, 15–70 μ thick (including the enclosed, usually thinner wall of the individual cell); upper face of the diaphragms often strongly mammillose or tuberculose with lamellate elevations, these 30–50 μ broad: filaments sometimes coherent or concrescent at points of casual contact by means of small, usually oval or quadrate, fibular cells: ordinary cells often forming cysts, either as a whole or after endogenous division (PLATES 13 and 14).

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* Schmitz. Sitzungsber. d. niederrheinischer Ges. f. Natur- und Heilkunde, 1879: 143. 1880.— Wille; Engler & Prantl, Nat. Pflanzenfam. 1^2: 140. 1890.

† Harvey-Gibson, R. J., & Auld, H. P. Codium. L. M. B. C. Memoirs, IV. 1900.

‡ We are aware that certain modern biologists object to applying the word "cell" to the segments of a coenocytic plant like *Siphonocladus*, but its use in this sense is historically and etymologically more accurate than its proposed modern restriction to the "energid" of certain physiologists. Moreover, no substitute entirely satisfactory to the systematist has been suggested. Proposed equivalents, like "segment," "compartment," and "coenocyte" are often either ambiguous or unnecessarily awkward.

Siphonocladus rigidus occurs in southern Florida and in the Bahama Islands, growing in water that is from 3 to 10 dm. deep at low tide, often in association with *Goniolithon strictum* Foslie. It is crisp and rigid when living, crunching under the collector's boot in the water somewhat like the *Goniolithon* whose society it affects. As is common in the family to which it belongs, the dried specimens give a poor idea of the living habit of the plant. Our *no. 1597* from Key West, Florida (October 30, 1902), from which the material used for the published photograph and for most of the drawings was taken, we consider the nomenclatorial type. Specimens collected under this number were distributed in the Phycotheca Boreali-Americana as *no. 1031* under the name *Siphonocladus tropicus* (Crouan) J. Ag.

Siphonocladus rigidus is probably more nearly related to *Siphonocladus brachyartrus* Svedelius,* from Magellan's Straits, than to any other described species, but *S. rigidus* is larger and coarser, the filaments measuring 350–1150 μ in thickness, while those of *S. brachyartrus* are given as but 200–300 μ, the cells are mostly even shorter proportionally than in *S. brachyartrus*, and the branching is more often and more truly dichotomous.

Siphonocladus rigidus is allied also to *S. tropicus* (Crouan) J. Ag., yet is sufficiently distinct as may be gathered from a comparison of our photograph of a fluid-preserved specimen (PL. *13*, F. *1*) with the photograph (PL. *13*, F. *2*) of the dried specimen in hb. Agardh, which was communicated by M. Mazé as "*Apjohnia tropica* Crouan" and may fairly be considered the type of the species, inasmuch as J. Agardh was the first (Till. Alg. Syst. **5**: 105. 1887) really to publish a description of it. The specimens from Florida, Barbados, and Mauritius, also cited by J. Agardh as belonging to that species, as well as specimens in herb. British Museum and herb. Mus. Paris., distributed by Mazé or by Mazé and Schramm as *Apjohnia tropica* Crouan, all maintain the peculiar habit of growth which reminded Agardh of *Chordaria flagelliformis* (*l. c.* p. 103). The most frequent mode of branching in *S. rigidus* is, on the whole, the dichotomous, and dichotomy, so far as we have observed, does not occur in *S. tropicus*. Occasionally, in *S. rigidus*, a fragment in which dichotomies are rare or perhaps wanting and lateral proliferations are numerous, like that illustrated in FIGURE 2, may bear a certain resemblance to *S. tropicus*, but this resemblance, we believe, is illusory,—is even less real than that of *Halimeda scabra* and *H. Tuna*. The cell-walls of *S. tropicus* are comparatively thin, measuring only 3–15 μ in thickness and the axes of the much elongated flagelliform branches are typically two or more cells broad, except at the extreme apices, while in *S. rigidus* the main branches are of a single series of cells for the greater part of their length; in *S. tropicus*, the ultimate lateral branches are rather uniformly and radially developed, in *S. rigidus* they are somewhat secund or very irregular in length and position; the peculiar mammillosities on the transverse walls, often conspicuous in *S. rigidus*, though not always present, we have never observed in *S. tropicus*.

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* Svenska Exped. till Magellansländerna, **3**: 304. *f. 3* and *pl. 18.* 1900.

In our earlier studies of *Siphonocladus rigidus* we had believed we saw the formation of zoöspores and pores for their escape through the wall of the cell, but did not succeed in finding such when the time came for drawing up the description. Cysts, however, are of common occurrence, and these may arise either by the separation and rounding off of the individual cells within the common filament sheath or by the endogenous division of these cells and the formation of new walls. The cells of the filament in the ordinary vegetative condition are rather easily separable from each other within the common filament sheath. FIG. 10 shows the result of applying pressure to the cover-slip above a filament-apex which had previously appeared transversely septate.

A curious and noteworthy feature of *Siphonocladus rigidus* is the apparently constant presence of the delicate hyphae of a fungus (?) closely appressed to its surface. These hyphae are variable in abundance, but we have never seen a branch or even a cell that was entirely destitute of them. The hyphae run, on the whole, parallel to the direction of growth of the host, either singly or laterally connate in bands of 2–4, occasionally with irregular pseudo-parenchymatous anastomoses, as shown in FIGURE 11. The hyphae are 2.5–6 μ broad, and septate, the cells being mostly 4–15 times as long as broad and each containing one or more colorless granules. No reproductive bodies have been observed. The fungus naturally suggests the epiphyte in *Blodgettia confervoides* Harv., to which epiphyte Professor E. Perceval Wright * has restricted the generic name *Blodgettia* under the binomial *Blodgettia Bornetii*, yet the two fungi are evidently different things, that on the *Siphonocladus* not only lacking the "conidia" of the other, but differing also in characters of the mycelium. Being uncertain to what extent fungus and alga may be symbiotically related, we have purposely omitted reference to the fungus in our specific diagnosis, preferring to ground the species on the alga alone. It is within the bounds of possibility that future investigations will serve to emphasize the apparent analogies of *Blodgettia confervoides* and *Siphonocladus rigidus* with the Lichenes and that some day there may be recognized a group of marine lichens in which the alga is the dominating symbiont.

Petrosiphon gen. nov.

A genus of Chlorophyceae of the family Valoniaceae.† Thallus crustaceous, lightly coated with lime, firmly adnate to the substratum by ventral rhizoids and conforming to the inequalities of its surface, composed of coherent irregularly septate tubes, these dichotomously branched or laterally proliferous as in the genus *Siphonocladus* (without septum at base of branch); the determinate progressive margin consisting of usually a single stratum of radially directed tubes, the older parts commonly showing in vertical section several irregularly superposed tubes, mostly with a radial direction, the central part, however, often consisting of vertical tubes of limited growth and nearly equal length, springing from a horizontal hypothallus. Cysts (aplanospores) frequent; other modes of reproduction unknown.

The genus *Petrosiphon* is allied to *Siphonocladus* Schmitz but is sufficiently differentiated from that by its flat, compact, crustaceous, more or less calcareous thallus, with determinate outline and radio-marginal growth. The type of the genus and the only species known to the writer is

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* On Blodgettia confervoides of Harvey, forming a new Genus and Species of Fungi. Trans. Roy. Irish Acad. **28**: 21–26. *pl. 2* 1881.

† See page 250.

Petrosiphon adhaerens sp. nov.

Forming light-green suborbicular patches, mostly 2–6 cm. in diameter, on rocks, often irregular in outline on an irregular substratum: margins radially striate or sulcate to the naked eye both when living and when dried, everywhere most closely appressed and adnate to the substratum; older central parts sometimes attaining a thickness of 3–5 mm.; tubes mostly 300–580 μ in diameter, those of periphery often nearly straight and sparingly subdichotomous, those of older parts commonly somewhat geniculate; cells ½–20 times longer than broad, cell-walls mostly 6 to 35 μ thick, conspicuously lamellate and often showing also transverse striae on surface; vertical tubes in central portion, when well developed, springing from a comparatively thin hypothallus, this commonly consisting of a single layer of horizontal tubes transformed by the vertical elongation of nearly all their component cells: calcification strongest in the vertical contact planes, the walls in these planes remaining rigid on drying while remainder of exposed wall of surface cells collapses, the surface of thallus becoming thereby radio-sulcate toward margin and usually spongiose-alveolate toward center: special fibular cells very rare, adjacent cells, however, often connected by horn-like or subconical processes: ventral rhizoids very numerous, rock-boring, tortuous, branched, septate, mostly 9–27 μ in diameter: cysts (aplanospores) extremely variable in size and form. (PLATE 15).

Common in the Bahama Islands, growing on surf-beaten calcareous rock near low-water mark and in tide-pools. Our *no. 3322*, collected January 23, 1905, in tide-pools on Silver Cay, near Nassau, from which our published photograph was taken, we consider the type of the species.

The thicker central portions of the thallus of this plant (exclusive of rhizoids) can be readily removed from the rock with a knife, but no specimen adequately representing the thinner marginal parts can be obtained without including also the rock substratum. The delicate rhizoids described above often give a green color to the rock for a depth of 1–2 mm. They are not ordinarily seen at all unless the subjacent rock is carefully decalcified together with the plant, when they appear as a dense tomentum adhering to the lower surface of all parts of the thallus except a very narrow zone at the growing margin. They are commonly more or less intertangled with filamentous, rock-boring Cyanophyceae. The larger rhizoids are occasionally formed by a ventral evagination of a part of the thallus-tube, the lumina of the two remaining continuous, but the ordinary slender rhizoids, the measurements of which are given above, appear from an early stage to be external appendages to the thallus-tubes, their basal cells standing in about the same relation to the walls of the main cells as do the small fibular cells of *Siphonocladus rigidus* shown in PLATE 14, FIG. 4.

Like *Siphonocladus rigidus*, *Petrosiphon adhaerens* is accompanied by a fungus, or, at least, a chlorophylless filamentous thallophyte, though this is not so uniformly present as in that species; we have never dissected a thallus in which it could not be found, yet large parts are sometimes destitute of it and we are of the opinion that its relation to the alga is that of a parasite rather than that of a subordinated symbiont. The external hyphae lie somewhat loosely among the thallus-tubes or rhizoids; they are fuscous, septate, 2.5–5 μ broad (cells mostly 2–15 times as long), for the most part sparingly branched, straight or sometimes contorted or torulose; the hyphae finally penetrate the walls of the thallus-tubes and follow their cavities in the direction of their growth, meanwhile becoming lighter-colored and forming much-elongated, ribbon-shaped or virgate-fasciculate, decompound clusters of branches; the cells of these endophytic branches are mostly 5–12 μ long, ellipsoid, oblong, or ovoid, and are occupied chiefly by a large vacuole, with 1–3 small refringent bodies usually lying close to the wall. Nothing which could be identified with reasonable certainty as a reproductive body of this fungus has been observed.

The only described species, so far as we can discover, which may suggest itself as possibly congeneric with *Petrosiphon adhaerens* is the minute *Siphonocladus voluticola* Hariot, which grows on the shells of *Voluta* in Tierra del Fuego. But this, according to the original description and figures,* and according to supplementary descriptions and figures by Bornet,† is quite different and

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*Jour. de Bot. **1**: 56. 1887; Mission scientifique du Cap Horn **5**: 22. *pl. 1. f. 2–4.* 1889.

†Bull. Soc. Bot. France **36**: clix, clx. *pl. 10. f. 1, 2.* 1889.

probably generically different. It does not form a solid, coherent thallus and nothing is said of a calcareous coating. Bornet (*l. c.*, p. clix) refers this *Siphonocladus voluticola* provisionally to the genus *Gomontia*, but states that this reference is doubtful owing to the imperfect condition of the specimen.

Petrosiphon may, without serious doubt, be placed in the family Valoniaceae as that family is defined by J. Agardh * and by Wille † and perhaps also in the Valoniaceae as more recently limited by Oltmanns, ‡ even though the genus *Siphonocladus*, with which we have compared *Petrosiphon*, is by Oltmanns excluded from the Valoniaceae and made the type of a separate family, the Siphonocladiaceae. But it may fairly be questioned, we think, whether the proposed separation of the Siphonocladiaceae and Valoniaceae as distinct families is not rather difficult and unnatural. The main point of distinction, as pointed out by Oltmanns, appears to be the existence of a "Hauptstamm" in the Siphonocladiaceae, which is lacking in the Valoniaceae. The historical type of the genus *Siphonocladus*, as described and figured by Schmitz, does indeed show a "Hauptstamm," but in most of the species which have since been referred to the genus by Hariot, § Bornet, ‖ Reinbold, ¶ and Svedelius,** the "Hauptstamm" is not readily distinguishable unless, perhaps, in the little-known early stages of growth. In the species described above under the name *Siphonocladus rigidus*, a main axis is soon lost when dichotomies occur as shown in FIGURE 1, but is evident when the branching is as shown in FIGURE 2; nevertheless, both these types of branching are sometimes found in a single tuft and represent, we believe, the variations of a single species.

The specimens from which the above descriptions of new algae have been drawn, including the actual materials which have served as a basis for the published photographs and drawings, are deposited in the herbarium and museum of the New York Botanical Garden. The dissections and microscopic preparations, have, however, been transferred from the glass slides, on which they were studied and figured, to glycerine-jelly mounts on slips of mica.

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* Till Alg. Syst. 5 : 11, 90. 1887.

† Eng. & Prantl, Nat. Pflanzenfam. 1² : 145. 1891.

‡ Morph. und Biol. der Algen, 1 : 255, 269. 1904.

§ Jour. de Bot. 1 : 56. 1887.

‖ Jour. de Bot. 1 : 56. 1887; De-Toni, Syll. Alg. 1 : 358, 359. 1889.

¶ Hedwigia 37 : (88) Beibl. 1898.

** Svenska Exped. till Magellansländerna 3 : 304. *f. 3* and *pl. 18*. 1900.

NEW YORK BOTANICAL GARDEN.

Explanation of plates 11-15

PLATE 11. *Halimeda scabra*

1. Photograph of plant, seven-ninths natural size. Specimen collected near Jupiter Inlet, Florida, by A. H. Curtiss, September, 1895.

2. Photograph of portion of fertile plant, one and one-half times natural size. Type specimen, *no. 2905* (Sands Key, Florida).

3. Upper part of the same, three times natural size.

PLATE 12. *Halimeda scabra*

1. Portion of margin of segment, decalcified, in surface view, × 65.

2–6. Peripheral utricles, teased out and decalcified, in lateral view, × 150.

7. Filaments of central strand, showing mode of fusion, × 38.

8–11. Sporangiophores and sporangia; 8 and 11, × 38; 9 and 10, × 24. In Fig. 11, the prevailing distichous arrangement of the sporangia is illustrated and in the older sporangia the position of the basal septum or plug is indicated.

Figs. 1, 3, 5, and 7–11 are drawn from the type specimen, *no. 2905* (Sands Key, Florida) and figs. 2, 4, and 6 from *no.* 2978 (Caesars Creek, Florida).

PLATE 13

1. Photograph of *Siphonocladus rigidus*, natural size. From *no. 1597*, collected at Key West, Florida, October 30, 1902, and now preserved in fluid in the museum of the New York Botanical Garden.

2. *Siphonocladus tropicus* (Crouan) J. Ag. Photograph of specimen in hb. Agardh, communicated by Mazé as *Apjohnia tropica* Crouan, — ⅞ natural size.

PLATE 14. *Siphonocladus rigidus*

1. Portion of plant, showing the more usual ramification, × 5. Near *a*, contiguous branches connected by small fibular cells had been pulled apart.

2. Portion of plant with numerous lateral branches or proliferations, × 5.

3. Surface view of a somewhat similar fragment, × 5.

4. Portion showing the small fibular cells and concrescence of branches at points of contact, × 16, optical section.

5, 6. Fibular cells, × 66.

7. Diaphragm showing mammilliform or tuberculiform elevations, in optical section, × 40.

8. About one-fifth the area of a diaphragm, showing mammilliform or tuberculiform elevations in surface view, × 66.

9. Cysts resulting from the division of the protoplast of a single cell, × 16.

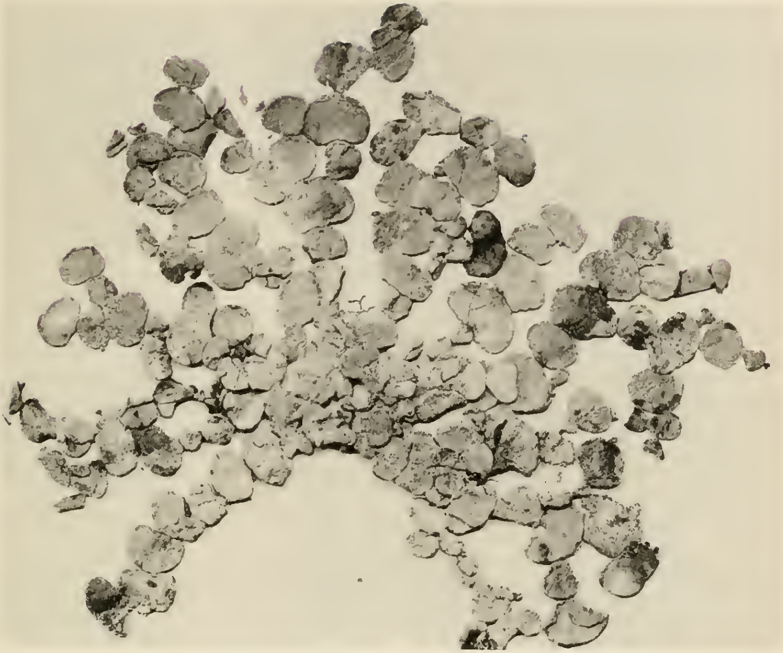
10. One of the filament-apices shown in Fig. 1 as it appeared after crushing under the cover-slip, × 16.

11. Hyphæ of a fungus (?), which is apparently always found on the surface of the cells of *Siphonocladus rigidus*, × 390.

Figures 1, 4–7, and 9–11, have been drawn from our *no. 1597* (Key West, Florida); figs. 2 and 3 from *no. 2771* (Cutler, Dade County, Florida) (similar branching, however, can be found in *no. 1597*); and fig. 8 from *no. 3046* (Hog Island, Nassau Harbor, New Providence, Bahamas).

PLATE 15. *Petrosiphon adhaerens*

A photograph of formalin-preserved specimens collected in tide-pools on Silver Cay, near Nassau, Bahamas, January 23, 1905 (*no. 3322*). The plants were photographed under an enlargement of 1¾ diameters in order to bring out better the radiating component tubes and this magnification is retained in the reproduction. The darker mass just below the middle of the upper right-hand plant is made up of various epiphytes.



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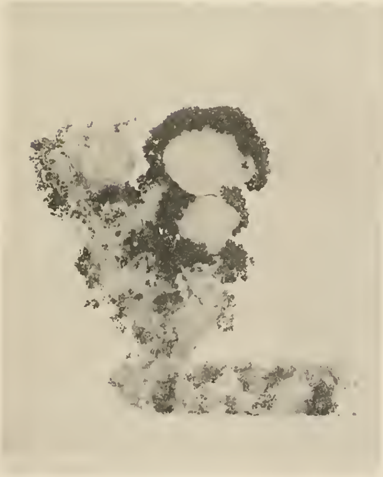

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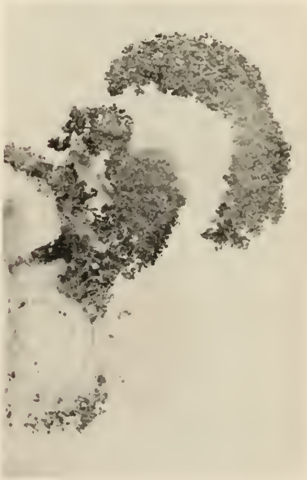

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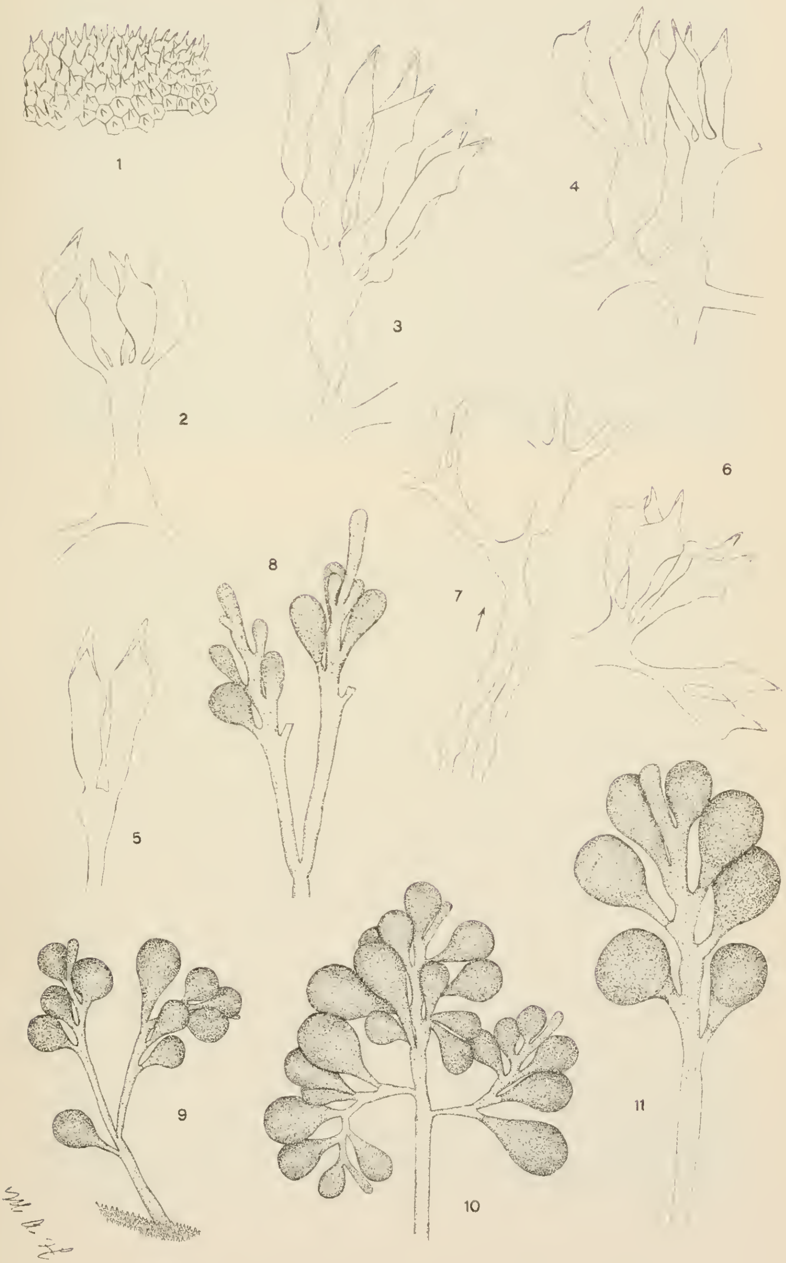
HALIMEDA SCABRA M. A. Howe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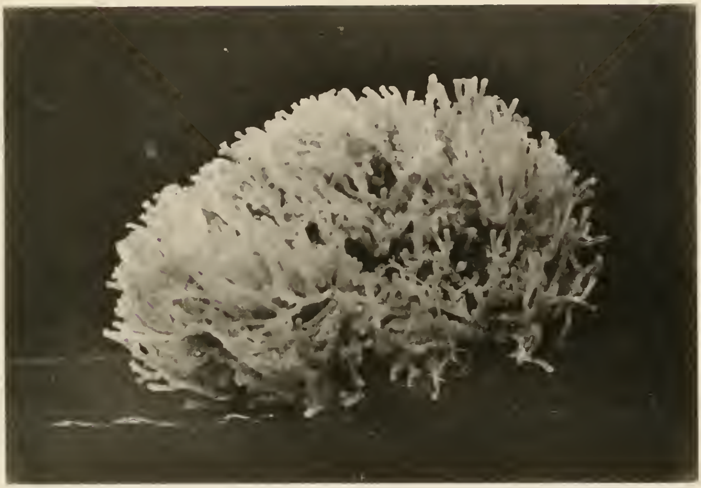
HALIMEDA SCABRA M. A. Howe.



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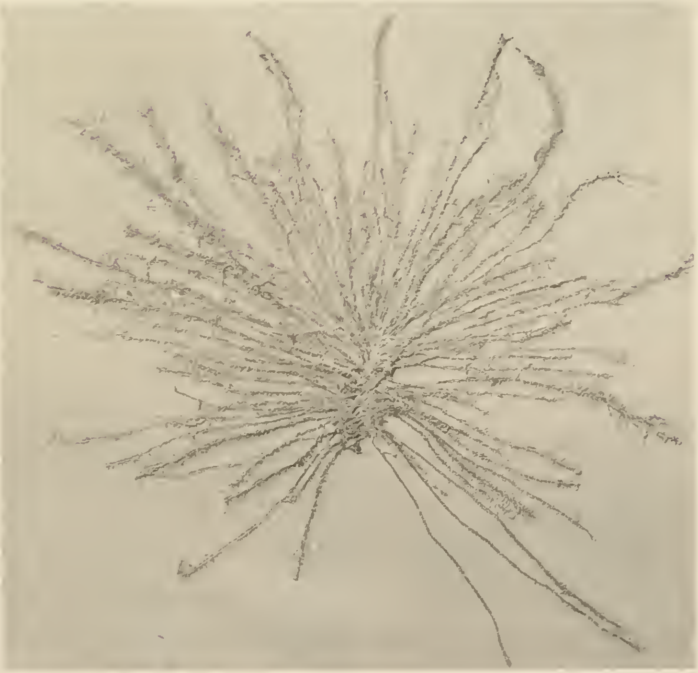

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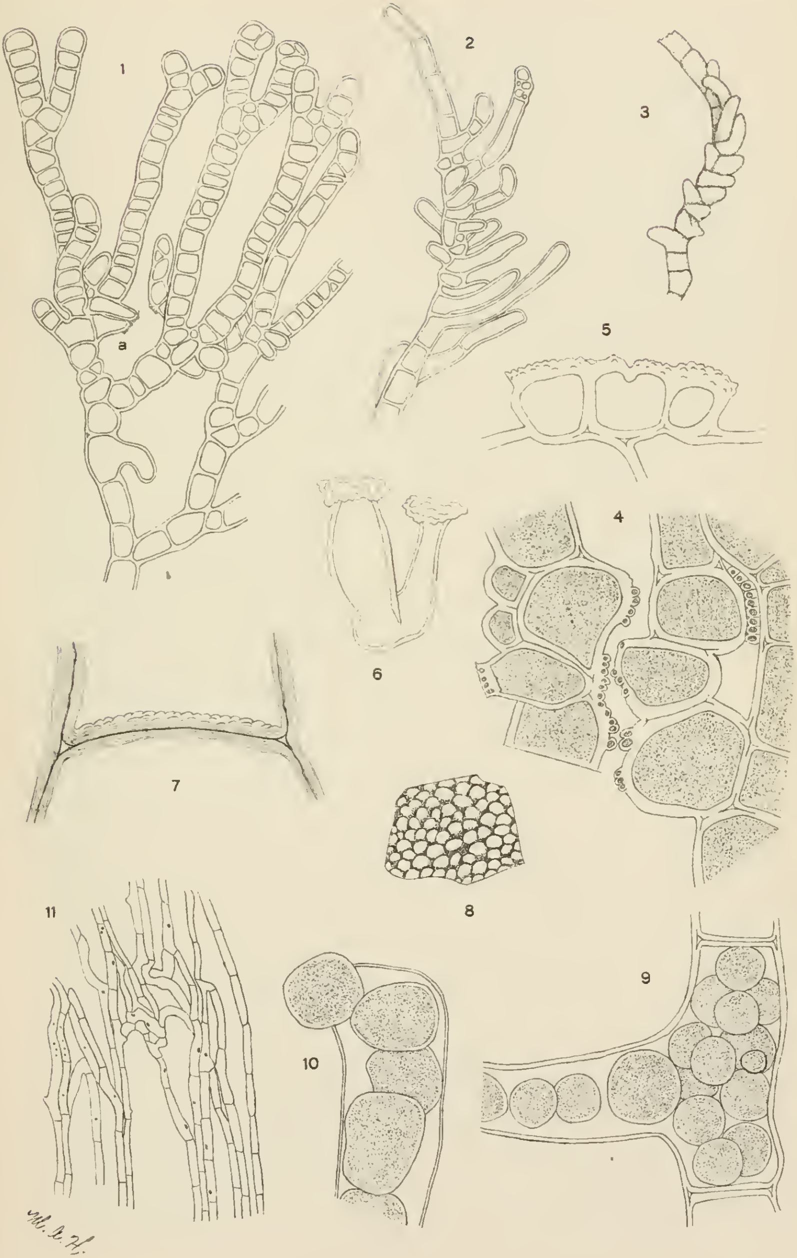
1. SIPHONOCLADUS RIGIDUS M. A. Howe
2. SIPHONOCLADUS TROPICUS (Crouan) J. Ag.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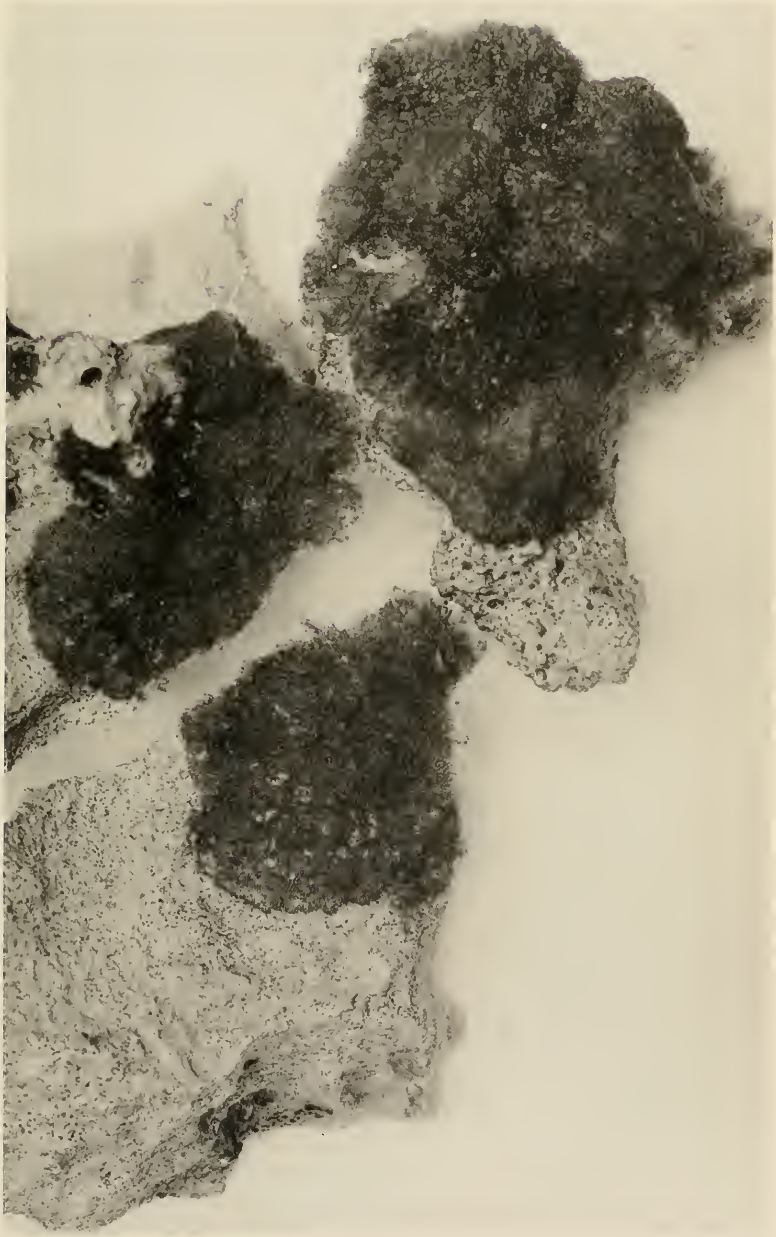
SIPHONOCLADUS RIGIDUS M. A. Howe.



PETROSIPHON ADHAERENS M. A. Howe

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, 32 : 261–268. 1905.]

Bryological Notes — II

ELIZABETH GERTRUDE BRITTON

SOME CHANGES IN GENERIC NAMES

Some recent studies of Dr. Small's subtropical Florida collections and of the mosses gathered by me in the Bahamas on two recent expeditions, as well as those from Jamaica collected by Mr. Harris, Mr. Maxon, and Professor Underwood, make it desirable to record some of the discoveries which I have made in trying to place some of the most puzzling species.

The following species was announced as a new species of *Cryphaea* at the Philadelphia meeting of the Sullivant Moss Chapter in December, and drawings were shown of it. I have since found that it is a common West Indian species which does not belong to any of the genera to which it has been referred, so I propose a new generic name, **Pseudocryphaea,** to include the one and only species known to me:

Pseudocryphaea flagellifera (Brid.)

? Hypnum nudicaule Schwaegr. Suppl. **1**^{2} : 223. 1816.
? Pterigynandrum nudicaule Brid. Bryol. Univ. **2** : 182. 1827.
Pilotrichum flagelliferum Brid. Bryol. Univ. **2** : 259. 1827.
Neckera domingensis C. Müll. Syn. Musc. **2** : 95. 1850.
Cryphaea ? leptoclada Sull. Proc. Am. Acad. **5** : 283. 1861.— Paris, Index 289.
Leucodon domingense Mitt. Jour. Linn. Soc. **12** : 409. 1869.— Paris, Index 755.

From the number of different genera in which it has been placed it is evident at first sight that there is something wrong with this species. It is not a *Leucodon*, as the leaves are costate; it is not a *Pilotrichella*, though it resembles *P. cymbifolia* in the slightly papillose leaves, formed by the projecting ends of the cells; the cells of the leaves resemble more closely those of *Leptodon trichomitrion*, but the plants differ in their striking method of branching and forming slender flagella; the specific names given to it by various authors show this to be the most marked characteristic of the species. The same habit is described by Correns in *Leucodon sciuroides*. He states that it is dioicous and seldom fruits and is propagated by brittle branchlets, a habit of tree-growing species. The young stems are unbranched and simple, but later they have short, small-leaved lateral branches which are brittle and fugacious!

The fruit has not been carefully described. This is a translation of what Müller says of it:

> "Perichaetium long-exserted, very narrow, pale; leaves long lanceolate-acuminate, convolute, long-reticulate; capsule on a long slender yellow pedicel, erect, ovate, brownish.
>
> "Very common throughout the Antilles and the neighboring borders of Venezuela, but very rarely fertile, first collected by Bertero in San Domingo.
>
> "A very beautiful and very distinct species. Fruit of *N. longiseta*."

We have this species from five stations near Miami, Florida, where it has been collected by *Garber* and by *Small*; also at Lake Harris, *J. D. Smith*, 1879. It was distributed from Cuba, *Chas. Wright 68*; Porto Rico, *Sintenis 53*, *Heller 578* and *820*, *O. F. Cook 1031*; Jamaica, *Underwood 2981* and *2015*, and *Maxon 843*. Also from Mexico, near Cordova, *C. Mohr*, 1857 and *Pringle 2146*.

In searching through the literature to see whether this species had previously been recorded from the United States, I found in Kindberg's *European and North American Bryinæ* that he includes *Alsia abietina* under *Leptodon* with *L. Smithii*, the type of the genus; that he separates *Leptodon trichomitrion* under *Forsstroemia* Lindberg, including five North American species; that he places under *Alsia*, *A. longipes* and *A. circinnata* (Brid.); and transfers *Alsia californica*, the type species of this genus, to *Antitrichia* and rechristens it *Antitrichia pseudo-californica*, because there was already an *Antitrichia californica* Sull. He transfers this last species to a new genus and calls it *Macouniella californica* Kindb. There are five distinct propositions here which will be taken up separately.

There is no question that *Leptodon Smithii* resembles *Alsia abietina* Sull. in its circinate habit, but it is a very superficial resemblance, which the leaf-characters at once dispel! There is a much greater resemblance to *Pterobryum densum* Hsch. in the shape, serration and venation of the leaves; but the prominent spinose teeth on the back are peculiar in *A. abietina*, and resemble those of *Pterogonium gracile*, though the size and habit of the plants is quite distinct, as well as the leaf-characters.

Most bryologists will admit that *Leptodon Smithii* and *L. trichomitrion* are not congeneric and accept *Forsstroemia* Lindb. for the latter and its allied species; but Paris' *Index*, although accepting both genera, limits *Forsstroemia* to *F. trichomitrion* (Hedw.) Lindb. and some other exotic species, and leaves most of our North American species in *Leptodon* with *L. Smithii*. Kindberg is more nearly correct in the list of species he includes, but *Cryphaea Ravenelii* belongs where Austin placed it!

Jaeger in the *Adumbratio* listed three of our species under *Lasia* Beauv. 1805 (*non* Bridel) but this generic name is antedated by *Lasia* Loureiro, 1790, and that is why Lindberg substituted *Forsstroemia* in 1862. Sullivant made an anagram of *Lasia* when he described *Alsia* because of the resemblance between *Lasia trichomitrion* (Hedw.) Beauv. and *Alsia californica* Sull. This is the type species of *Alsia* and its synonymy is as follows:

ALSIA CALIFORNICA (Hook. & Arn.) Sull. Proc. Am. Acad. Arts & Sci. **3**: 185. 1857; Musc. Wilkes Exp. 25. *pl. 25*. 1859.

Neckera californica Hook. & Arnott, Bot. Beechey Exp. 162. 1833.

Antitrichia pseudo-californica Kindb. Eu. and N. A. Bryin. 9. 1897.

It started as a monotypic genus, and it was not till 1864, in the *Icones*, that Sullivant enlarged the genus to include *Neckera abietina* Hooker. This was undoubtedly a mistake which Kindberg has detected, but failed to rectify in the correct way. I therefore propose the following new name:

Dendroalsia

Type species: **Dendroalsia abietina** (Hook.)

Neckera abietina Hook. Musc. Exotici *pl. 7*. 1818.

Pilotrichum abietinum Brid. Bryol. Univ. **2**: 258. 1827.

Type locality: N. W. Coast of North America. *Menzies*, 1792.

Type in herbarium of Hooker.

These plants were figured 6 inches high, with stems naked at base for 2–3 inches, simply pinnate or bipinnately compound (often with flagelliferous branches 2–3 inches long) leaves long-acuminate. The cells are dorsally papillose to base, papillae are larger at apex, spinose especially on the end of the vein, seta not entirely immersed, capsule cylindric, 3 mm. long; peristome pale, papillose and densely nodose: endostome slightly perforate, also pale and papillose.

Hooker says that the peristome is red and the endostome pale-yellow, but Schwaegrichen, *pl. 140*, in a colored plate, figures the peristome as a light yellowish-green.

Apparently this is a very rare species and it is doubtful if Sullivant saw typical specimens!

It is also to be remembered that Sullivant included among the synonyms of *Alsia abietina* his *Leptodon circinalis.* Again it seems clear that Sullivant made a mistake in supposing that Hooker's specimens were the same as his and in stating that Hooker's specimens were not typical and that the smaller circinate plants were the antheridial plants of the larger. He says: "The specimens collected by Menzies, and figured by Hooker and Schwaegrichen (*l.c.*), are unusually elongated and distinctly pinnate, owing doubtless to local influences, and therefore do not represent the normal form of the species, as here figured from numerous specimens furnished by other collectors." A comparison of Sullivant's figures with those cited above will show the macroscopic as well as the microscopic differences between these two species. Specimens of *Dendroalsia abietina* have been sent to me by J. B. Leiberg from granite ledges near Lake Pend d'Oreille, Idaho, which measure 8–10 inches in length, are doubly pinnate and have long slender flagellate branches. They are also much less circinate and show other differences from the smaller species, as the following synopsis and description will indicate:

Plants 4–10 inches high. Leaves papillose to base. *D. abietina.*
Plants 2–4 inches high. Leaves papillose only at apex. *D. circinalis.*

Dendroalsia circinalis (Sull.)

Leptodon circinalis Sull. Bot. Pac. R.R. Survey. 4: 189. *pl. 1.* 1856.

Alsia abietina Sull. (in part) Icon. Musc. 115. *pl. 72b.* 1864.

Alsia Macounii Kindb. Bull. Torrey Club **17**: 275. 1890.

Plants seldom more than 3–4 inches high, more circinate when dry than *D. abietina*: leaves shorter, 1 mm., and broader, 0.5 mm., ovate-lanceolate, less serrate and acuminate at apex, papillose only above the middle, papillae smaller and more numerous; base broader with strongly revolute margins, vein stouter and less spinosely toothed at apex: capsules shorter and broader, with a shorter seta more completely immersed in the broader and less pointed, perichaetial leaves; peristome longer and more slender, less papillose; endostome perforate; spores larger and rougher.

According to Kindberg, the only American species of *Alsia* is *A. longipes* Sull. & Lesq., with which he associates a European species of *Eurhynchium*, *E. circinnatum* (Brid.) Br. & Sch. This is another case of incomprehensible confusion, for apparently, there is no resemblance, either superficial or real between these two species.

Alsia longipes has the leaf-characters of *Dendroalsia*, but differs in its sporophyte in several ways, having a long-exserted seta, a cylindric capsule and an endostome with appendiculate cilia. Still there seems no necessity for separating it from the other allied species, so the following name is proposed:

Dendroalsia longipes (Sull. & Lesq.).

Alsia longipes Sull. & Lesq. Musc. Bor.-Am. Ed. 2. *No. 399*. 1865. Sull. Icon. Musc. Supp. 85. *pl. 63*. 1874.

Type station: On shaded rocks in deep canyons, Oakland, California, *Bolander*. This species must be rare, as it is recorded from only two other stations in California, *viz.*, near Berkeley, *M. A. Howe*, and southern California, *McClatchie*, and one in Alaska.

MACOUNIELLA Kindberg.

It is with much regret that I am forced to believe that the genus *Macouniella* Kindb. will not stand. As has already been stated, the genus was founded on *Antitrichia californica* Sull. and some specimens from France were referred to it. The type species of *Antitrichia* is *A. curtipendula*. Limpricht in the Laubmoose maintains in the same genus *A. californica* Sull. to which *A. curtipendula* var. *hispanica* Sch. including specimens from Algiers, Spain and Italy, had been referred by Schimper himself. He gives a short and excellent key to separate them, which is translated as follows:

Leaves plicate, with accessory veins.	*A. curtipendula.*
Leaves not plicate, with only one vein.	*A. californica.*

A careful comparison of European specimens, descriptions and illustrations has convinced me that all five of the differences claimed by Kindberg to separate var. *gigantea* as a species, are variable and unreliable. A large series of European specimens in the Jaeger Herbarium shows this and the description given by Limpricht in the *Laubmoose* indicates a variable species. He states that the stems may be simple or branched, the branches thick at the apex or slender, often flagellate; the leaves mostly serrate, with 1–2 accessory veins on each side of the midvein; and the seta straight or curved. He recognizes two varietal names in a footnote but evidently considers them of little importance.

Antitrichia tenella Kindb. and var. *flagellifera* R. & C. seem referable to *A. curtipendula* and are probably one and the same thing.

THE AMERICAN SPECIES OF ERPODIUM

In both editions of Paris' Index Bryologicus this genus is credited to Bridel, yet he used it only as a *subgenus* of *Anoectangium* and Carl Müller (Bot. Zeit. **1**: 774. 1843) was the first to use it as a generic name. Of the 20 species recognized, 9 are credited to America, 3 are from Paraguay, 2 from Argentina, 2 from Brazil, 1 from Mexico and 1 from the West Indies. Of these *Erpodium domingense* is reported as having been collected in Cuba, Jamaica and Porto Rico, but the type station Sto. Domingo is omitted from the second edition, though it is the only one cited in the first! Recent collections from Jamaica by Professor Underwood include one specimen of this rare and interesting genus, which I have referred to *Erpodium domingense* from the descriptions only, not having any specimens for comparison! *Erpodium domingense* is the type species.

ERPODIUM DOMINGENSE (Brid.) C. Müll. Bot. Zeit. **1**: 773. 1843.
Anoectangium Erpodium domingense Brid. Bryol. Univ. **2**: 167. 1827.

Anoectangium? domingense Schwaegr. Suppl. *pl. 267.* 1829–30.
Pilotrichum domingense C. Müll. Syn. Musc. **2**: 184. 1851.

Type locality: Sto. Domingo. Coll. *Balbisius.* On trees.

Plants closely appressed, light-green or brown; stems creeping and rooting, branches short and irregular. Leaves imbricated and appressed, overlapping half their length, ecostate, entire but the margins crenulate with papillae; apex rounded; cells large, 0.013 x 0.018 mm., all thick and obscure; basal cells longer and smooth: autoicous: antheridia few, in a small axillary bud without paraphyses: archegonia terminating short lateral branches; perichaetial leaves with acute spreading points: seta short, nearly or quite immersed: capsules erect, 1 mm. long, cylindric, pale-yellow, contracted below the mouth when dry, walls parenchymatic, thin at base; neck stomatose; peristomes none, lid conic, apiculate; calyptra not seen; spores green, smooth, 0.027–0.032 mm.

On trees in Sto. Domingo, Porto Rico and Hope Mines near Kingston, Jamaica, *L. M. Underwood 4*, 24 January, 1903.

Remarkable for its resemblance to the *Hepaticae*, especially certain species of *Frullania* for which it has been mistaken and hence probably has seldom been collected.

Erpodium cubense E. G. Britton, n. sp.

Erpodium domingense fide Paris Index ed. 2. 156?

Only a few scraps selected from Charles Wright's Cuban Hepaticae by C. F. Austin have been seen, so the general aspect of this species is unknown, but the leafy stems are similar to those of *Erpodium domingense* and might easily be mistaken for them. The leaves, however, are smaller and more blunt at apex; the marginal apical cells are rectangular and smaller, only 0.005–0.008 mm. and obscure, with small dense papillae; the cells are rhomboidal in the upper part of the perichaetial leaves and 0.008 x 0.013 mm.; the capsule is sessile and quite immersed, only 0.5 mm. long, "with a fragmentary peristome" *fide* Austin; the calyptra 0.25 mm. with lobed base; spores 0.013 mm. Found by Austin with *Lejeunea, no. 201g* of Wright's Cuban Hepaticae. Type from the Herbarium of C. F. Austin.

Type locality?

This species differs from *E. domingense* in having leaf-cells one-half the size and more dense and obscure, and in its smaller and immersed capsule.

These specimens were in the herbarium of P. V. LeRoy for many years and have been purchased by the New York Botanical Garden.

ERPODIUM BISERIATUM (Austin) Austin, Bot. Gaz. **2**: 142. 1877.
Lejeunea biseriata Austin, Proc. Acad. Sci. Phila. **21**: 225. 1869.

Stems slender, 1 cm. long and (with leaves) about 1 mm. wide. Leaves 0.40–0.50 mm. long, unequal at base, cells at apex distinct, hexagonal or rounded, 0.003 × 0.013 mm. in diameter with thick brown walls, basal and central cells longer and narrower, 0.010 × 0.040 mm., the translucent marginal cells not papillose, dorsal cells with from 4–8 minute papillae. Fruit unknown.

Collected with *Lejeunea Sullivantii* by *W. S. Sullivant* near Augusta, Georgia, in 1845.

These specimens and a full series of notes were sent to Manchester, England, with Austin's hepatics and remained there a number of years in the herbarium of W. H. Pearson. They were subsequently returned and placed among the *Hepaticae* in the Columbia University Herbarium where they were found by Dr. M. A. Howe.

Erpodium Pringlei E. G. Britton, n. sp.

Plants in thin, appressed, glaucous-green mats: stems creeping and branching, branches short: leaves densely imbricate, squarrose with spreading points, ovate, 0.5 mm. long, apex acute or obtuse, papillose or hyaline, the cells hexagonal, papillose, large, 0.013 × 0.021 mm. in diameter, with brown walls thickened at angles, collenchymatic; margins entire or minutely papillose-crenulate, basal cells elongated and smooth; perichaetial leaves scarious, erect-clasping, apiculate, with clear apical cells; capsule half-immersed, 1 mm. long, lid apiculate, mouth bordered by red cells as well as the lid; peristome none: spores rough, 0.027–0.035 mm.

Type station: Mexico, near Guadalajara, *C. G. Pringle*, 1889, *no. 710*, on trees; Zapotlen, May 28, 1893, and Terzuela, July 2d, 1893, *no. 16a*.

This genus is not recorded for Mexico by Bescherelle in his *Prodromus Bryologiae Mexicanae*. Dr. Max Fleischer states that *E. diversifolium* C. Müll. appears to be only *E. domingense*!

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THE POLYPORACEAE OF NORTH AMERICA—XI

A SYNOPSIS OF THE BROWN PILEATE SPECIES

By WILLIAM ALPHONSO MURRILL

NEW YORK
1905

[From the BULLETIN OF THE TORREY BOTANICAL CLUB **32**: 353-371. July 1905]

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, 32: 353-371. 1905.]

The Polyporaceae of North America — XI. A synopsis of the brown pileate species

WILLIAM ALPHONSO MURRILL

An attempt is made in the present paper to summarize in convenient form for reference the results of former studies covering all North American polypores having a distinct pileus with dark-colored substance, and, in addition, to give generic keys and diagnoses of new genera not already treated that come within this subgroup.

FAMILY POLYPORACEAE

Hymenophore annual or perennial: context fleshy-tough, corky or woody; hymenium poroid or lamelloid, fleshy to woody, never gelatinous.

Synopsis of the subfamilies

- Hymenium porose.
  - Hymenophore annual. 1. POLYPOREAE.
  - Hymenophore perennial. 2. FOMITEAE.
- Hymenium furrowed. 3. AGARICEAE.

Subfamily 1. POLYPOREAE

Hymenophore varied in size and shape, fleshy-tough to corky, annual, sometimes reviving and rarely perennial in the tropics; surface encrusted or anoderm, glabrous or hairy, zonate or azonate: context fibrous, rarely punky, variously colored; tubes cylindrical, sometimes splitting into teeth, usually thin-walled: spores rounded or oblong, brown or hyaline, cystidia frequently present, surface of pileus never conidia-bearing: stipe often present, variously attached.

Synopsis of the Polyporeae with brown context

- Hymenophore sessile.
  - Spores hyaline.
    - Context light-brown.
      - Context at first fleshy, becoming slightly corky. 1. *Ischnoderma.*
      - Context tough from the first.
        - Surface encrusted. 2. *Antrodia.*
        - Surface not encrusted.
          - Surface glabrous or nearly so.

Hymenium alveolate.	3. *Favolus.*
Hymenium normally poroid.	4. *Hapalopilus.*
Surface distinctly hairy.	
Tubes large and irregular.	5. *Funalia.*
Tubes small and regular.	6. *Coriolopsis.*
Context dark-brown.	
Context duplex, mostly of intricately woven black hairs.	7. *Trichaptum.*
Context simple.	
Context friable.	14. *Phaeolus.*
Context tough.	
Tubes yellow.	8. *Flaviporus.*
Tubes brown, rarely greenish.	
Tubes entire, surface heavily bearded.	9. *Pogonomyces.*
Tubes soon splitting into teeth, surface velvety.	10. *Cerrenella.*
Tubes black.	11. *Nigroporus.*
Spores brown.	
Hymenophore thin, dry, multizonate.	12. *Cyclomycetella.*
Hymenophore not as above.	13. *Inonotus.*
Hymenophore stipitate.	
Spores hyaline.	14. *Phaeolus.*
Spores brown.	
Pileus inverted, pendant.	15. *Coltriciella.*
Pileus erect, stipe central.	16. *Coltricia.*

1. ISCHNODERMA Karst. Medd. Soc. Faun. et Fl. Fenn. 5: 38. 1879

Type: *Ischnoderma fuliginosum* (Scop.) Murr.

Hymenophore large, annual, epixylous, sessile; surface pelliculose, glabrous: context light-brown, fleshy to slightly corky, friable when dry; tubes small, thin-walled: spores smooth, hyaline.

Species: *I. fuliginosum* (Scop.) Murr. [see Bull. Torrey Club **31**: 606, 607. 1904.]

2. ANTRODIA Karst. Medd. Soc. Faun. et Fl. Fenn. 5: 40. 1879

Type: *Antrodia mollis* (Sommerf.) Karst.

Hymenophore small, annual, epixylous, sessile or semi-resupinate; surface zonate, encrusted, glabrous: context thin, light-brown, fibrous; tubes short, firm, thin-walled: spores smooth, hyaline.

ANTRODIA MOLLIS (Sommerf.) Karst.

Daedalea mollis Sommerf. Suppl. Fl. Lapp. 271. 1826.

Trametes mollis Fr. Hym. Eur. 585. 1871.

Antrodia mollis Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 40. 1879.

Trametes stereoides Bres. Att. I. R. Accad. Sc. ed Art. III. **3**: 92. 1897.

According to Bresadola, this species is the same as *Polyporus stereoides* Fr. (Obs. Myc. **2**: 258. 1818), described from very small specimens collected on old fir trunks in Sweden, but different from *Polyporus cervinus* of Persoon (Myc. Eur. **2**: 87. 1825).

The plant is fairly well known in Europe and temperate North America on decaying wood of beech, maple, linden and other deciduous trees: Finland, *Karsten;* Hungary, *Kmet;* Tyrol, *Bresadola;* Canada, *Ellis*, *Macoun*, *Dearness;* Maine, *Blake;* New York, *Peck;* Ohio, *Lloyd.*

3. FAVOLUS Beauv. Fl. Owar **1**: 1. *pl. 1.* 1805

Type: *Favolus hirtus* Beauv.

Scenidium Kuntze, Revis. Gen. 515. 1893.

Type: *Favolus hirtus* Beauv.

Hymenophore small, annual, epixylous, sessile, dimidiate or reniform; surface multizonate, margin thin: context thin, leathery, pallid or brown; tubes alveolar: spores smooth, hyaline.

Species: *F. tenuis* (Hook.) Murr., *F. variegatus* (Berk.) Murr. [see Bull. Torrey Club **32**: 99–103. 1905]. Although typically white-fleshed, this genus contains brown forms and *F. variegatus* is usually brown.

4. HAPALOPILUS Karst. Rev. Myc. **3**: 18. 1881

Type: *Hapalopilus rutilans* (Pers.) Murr.

Hymenophore annual, very rarely perennial in the tropics, epixylous, sessile, dimidiate, simple or imbricate; surface anoderm, rarely pelliculose, zonate or azonate, usually brown and glabrous: context brown, leathery or corky, tough or rarely friable when dry; hymenium usually differently colored, tubes small, thin-walled: spores small, usually ovoid, hyaline.

Species: *H. rutilans* (Pers.) Murr., *H. sublilacinus* (Ell. & Ev.) Murr., *H. licnoides* (Mont.) Murr., *H. gilvus* (Schw.) Murr., *H. fulvitinctus* (B. & C.) Murr., *H. hispidulus* (B. & C.) Murr. [see Bull. Torrey Club **31**: 415–419. 1904].

5. FUNALIA Pat. Tax. Hymen. 95. 1900

Type: *Funalia Mons-Veneris* (Jungh.) Pat.

Hymenophore annual, epixylous, sessile, dimidiate, often semiresupinate; surface anoderm, hairy: context light-brown, duplex, spongy above, coriaceous to woody below; tubes usually large, thin-walled, more or less lacerate: spores smooth, hyaline.

Synopsis of the North American species

1. Northern species; context thick, firm, tubes circular to angular, concolorous. 1. *F. stuppea.*
Southern species, confined to the Gulf States and tropical America. 2.
2. Surface hairs small and simple, entire plant soft and flexible. 2. *F. villosa.*
Surface hairs conspicuously branched and tufted, plant more or less rigid. 3. *F. cladotricha.*

1. **Funalia stuppea** (Berk.)

Trametes stuppeus Berk. Ann. Nat. Hist. **7**: 453. 1841.

Trametes Peckii Kalchb. Bot. Gaz. **6**: 274. 1881.

Described originally from Dr. Richardson's collections at Carlton House, British America, in 1841 and again forty years later from specimens collected by Irish on dead cottonwood trunks in Dakota. Kalchbrenner's description is translated by Peck as follows:

"Pileus corky, dimidiate, sessile, subdecurrent, hairy, zoneless, brownish-ferruginous, becoming pale, the margin acute; pores rather large, varying from rotund to angular, colored nearly like the pileus or when old becoming brown; substance wood-color."

This species is abundant in certain parts of northern and western North America on dead stumps and trunks of cottonwood and other species of poplar. What appears to be a modified form of the same plant has been found on dead willow trees in Kansas. Although similar, all forms of this species are distinct from *Trametes hispida* Bagl. of Europe.

British Columbia, *Macoun;* Montana, *Anderson;* Dakota, *Irish;* Colorado, *Crandall, Cowen;* Kansas, *Bartholomew;* Missouri, *Demetrio;* New Mexico, *Earle.*

2. **Funalia villosa** (Sw.)

Boletus villosus Sw. Prodr. 148. 1788. Fl. Ind. Occ. **3**: 1923. 1806.

Favolus villosus Fr. Syst. Myc. **1**: 344. 1821.

Polyporus villosus Fr. Epicr. 475. 1836–38.

Described originally from plants collected on dead trees in Jamaica as follows:

"B. acaulis, submembranaceus fasciatus griseo-albidus villosus, poris difformibus dentatis."

In his later work Swartz largely supplements the above description. Fries probably did not see the plant until after 1821. Resupinate Cuban forms were determined by Berkeley as *Polyporus cavernulosus* Berk. (Hook. Jour. Bot. **8**: 235. 1856), first described from Brazil, while semi-resupinate and pileate forms from tropical America and the Gulf States have long been known as *Polyporus versatilis* Berk. (Lond. Jour. Bot. **1**: 150. 1842), described originally from Cuming's collections in the Philippines.

This species is fairly common in the West Indies and Central America, and has been collected in quantity by Langlois in Louisiana. It appears to grow equally well on deciduous and coniferous wood, and varies much in appearance, consistency and size of pores, on all hosts.

Louisiana, *Langlois;* Florida, *Calkins;* Jamaica, *Earle 430;* Cuba, *Earle & Murrill 169, 294, 550, 598, 626;* Nicaragua, *Smith, Shimek.*

3. **Funalia cladotricha** (B. & C.)

Polyporus cladotrichus B. & C. Jour. Linn. Soc. Bot. **10**: 309. 1868.

Collected by Wright on dead wood in Cuba and thus described:

"Pileo dimidiato vel e decurrente reflexo strigoso brunneo; poris mediis angulatis, dissepimentis rigidis demum laceratis dentatis."

"Pileus 2–3 inches broad, 1–2 inches long; pores $\frac{1}{36}$ inch in diameter, 2 lines deep. The pileus has a spongy strigose coating, but not consisting of decumbent fibres as in the last (*P. trichomallus*). *P. endothrix* Berk., from the river Amazon, has much smaller pores."

SPECIES INQUIRENDAE

Polyporus Lindheimeri B. & C. Grevillea **1**: 50. 1872. Described from plants collected by Lindheimer on *Laurus Sassafras* in Texas as follows:

"Pileus $1\frac{1}{4}$ inch wide, $\frac{1}{2}$ long, often laterally confluent, dirty white, tinged with ash-color, floccose, here and there slightly strigose; hymenium cinereous; pores $\frac{1}{100}$ inch wide, angular."

The type of this species at Kew is very old and partially destroyed by insects, so that little can be known of the plant until new collections are made in the type locality.

6. **Coriolopsis** gen. nov.

Type: *Polyporus occidentalis* Kl. Linnaea 8: 486. 1833.

Hymenophore thin, flexible or rigid, annual, epixylous, sessile, dimidiate, often largely resupinate; surface light-brown, zonate, anoderm, hairy, margin thin: context thin, coriaceous to woody, pale ferruginous, sometimes almost white; hymenium concolorous, tubes small, regular, thin-walled, entire: spores smooth, hyaline.

Synopsis of the North American species.

1. Pores conspicuous. 2.
Pores inconspicuous, pileus papery, thin, very flexible.
1. *C. crocata.*
2. Pores yellowish-brown, pileus usually rather thick and firm.
2. *C. occidentalis.*
3. Pores white or pallid, pileus thin, often narrowly reflexed or entirely resupinate.
3. *C. gibberulosa.*

1. **Coriolopsis crocata** (Fr.)

Polyporus crocatus Fr. Epicr. 477. 1836–38.
Polyporus byrsinus Mont. Pl. Cell. Cuba 391. *pl. 15. f. 3.* 1842.
Polystictus crocatus Fr. Nov. Symb. 91. 1851.

Described originally from plants collected on trunks in Mexico by Liebmann. Confused with *C. occidentalis* by many, but plainly distinct. The species has until recently been but sparingly collected in tropical America, as the following specimens at hand will indicate.

Colombia, *Baker;* Nicaragua, *Wright 237, Smith;* Mexico, *Smith;* Cuba, *Wright 306½; Underwood & Earle 1580, Earle & Murrill 121, 125, 237, 351, 379, 499, 644.*

2. **Coriolopsis occidentalis** (Kl.)

Polyporus occidentalis Kl. Linnaea 8: 486. 1833.
Polyporus lenis Lév. Ann. Sci. Nat. Bot. III. 9: 123. 1848.
Polystictus cyclodes Fr. Nov. Symb. 90. 1851.

This species was first described from plants in Hooker's herbarium, collected on trunks in the island of St. Vincent by Guilding. *Polyporus lenis* was assigned to specimens collected on trunks in America by Mougeot and *Polystictus cyclodes* to collections made in the island of San Jan by Oersted. These are probably not half of the names under which the species has been known.

The plant is exceedingly common on dead wood of various kinds throughout tropical America, the following list comprising only a few of the numerous collections examined:

Colombia, *Baker;* Yucatan, *Millspaugh;* Honduras, *Wilson, Brown;* Mexico, *Smith;* Jamaica, *Earle;* Cuba, *Earle, Murrill, Underwood, Britton, Shafer, Hamilton;* Porto Rico, *Earle.*

3. **Coriolopsis gibberulosa** (Lév.)

Polyporus gibberulosus Lév. Ann. Sci. Nat. Bot. III. **5**: 139. 1846.

Polystictus extensus Cooke; Sacc. Sylloge Fung. **6**: 244. 1888.

Described by Léveillé from Kegel's collections in Dutch Guiana and by Cooke from specimens named by Berkeley in the Hooker herbarium, collected in British Guiana. Cooke published Berkeley's name in Grevillea **14**: 82. 1886 without a description.

The species ranges northward in varying forms to Central America and the West Indies. The context is not white, but pale ferruginous. Specimens are at hand from Ecuador, *Lagerheim;* Colombia, *Baker;* Mexico, *Smith, Shimek;* Nicaragua, *Smith, Baker 2513;* Jamaica, *Earle 480;* Cuba, *Earle 548, 580, 1105, Underwood & Earle 1496, 1500, Earle & Murrill 30, 85, 119, 120, 128, 134, 136, 206, 214, 218, 223, 259, 330, 343, 368, 384, 394, 400, 418, 452, 645.*

Species inquirendae.

Polyporus myrrhinus Kickx, Bull. Acad. Bruxell. **5**: 370. 1838.

Polystictus cascus Fr. Nov. Symb. 88. 1851.

Trametes rigida Berk. & Mont. Ann. Sci. Nat. Bot. III. **11**: 240. 1849. (*Polystictus rigens* Sacc. & Cub.; Sacc. Sylloge Fung. **6**: 274. 1888.)

7. TRICHAPTUM Murr. Bull. Torrey Club **31**: 608. 1904

Type: *Trichaptum trichomallum* (Berk. & Mont.) Murr.

Hymenophore annual, epixylous, sessile, dimidiate: context brown, firm and leathery below, very loosely fibrous and darker above; tubes short, thin-walled, mouths polygonal, at times becoming labyrinthiform: spores smooth, hyaline.

Species: *T. trichomallum* (Berk. & Mont.) Murr. [see Bull. Torrey Club **31**: 608, 609. 1904].

8. **Flaviporus** gen. nov.

Type: *Polyporus rufoflavus* B. & C. Jour. Linn. Soc. Bot. **10**: 310. 1868.

Hymenium annual, often reviving, epixylous, sessile, dimidiate, imbricate; surface encrusted, glabrous: context thick, woody, brown; tubes thin-walled, minute, regular: spores smooth, hyaline.

Synopsis of the North American species

Hymenium pale lemon-yellow.	1. *F. rufoflavus.*
Hymenium deep orange-colored.	2. *F. crocitinctus.*

1. **Flaviporus rufoflavus** (B. & C.)

Polyporus rufoflavus B. &. C. Journ. Linn. Soc. Bot. **10**: 310. 1868.

Polyporus Braunii Rabh. Rabenhorst's Fung. Europ. Exsic. *no. 2005.*

Described from Wright's collections in Cuba. Known also from Venezuela through Fendler, and from Mexico through the collections of C. L. Smith. Plants later described as *P. Braunii* were found on palms, which were doubtless brought from tropical America. The name assigned by Berkeley refers to the red surface and bright-yellow hymenium of the plant.

2. **Flaviporus crocitinctus** (B. & C.)

Polyporus crocitinctus B. & C. Journ. Linn. Soc. Bot. **10**: 311. 1868.

The type, collected in Cuba by Wright, is well preserved at Kew. The species has not since been collected.

9. POGONOMYCES Murr. Bull. Torrey Club **31**: 609. 1904

Type: *Pogonomyces hydnoides* (Sw.) Murr.

Hymenophore annual, epixylous, dimidiate-sessile to flabelliform, thickly covered with rigid hairs: context dark-brown, punky; tubes short, thick-walled, light brown, mouths small, circular: spores smooth, hyaline.

Species: *P. hydnoides* (Sw.) Murr. [see Bull. Torrey Club **31**: 609, 610. 1904].

10. **Cerrenella** gen. nov.

Type: *Irpex tabacinus* B. & C. Grevillea **1**: 102. 1872.

Hymenophore thin, effused-reflexed, annual, epixylous; surface brown, zonate, anoderm, margin thin: context thin, coriaceous, brown; hymenium at first poroid, very soon becoming irpiciform, the teeth irregular and compressed: spores smooth, hyaline.

Synopsis of the North American species

Hymenium concolorous, teeth bright-brown in color. 1. *C. tabacina.*

Hymenium of a different color from the pileus, teeth covered with a greenish bloom. 2. *C. coriacea.*

1. **Cerrenella tabacina** (B. & C.)

Irpex tabacinus B. & C. Grevillea **1**: 102. 1872.

Described from plants collected by Curtis in the Carolinas. Its favorite host is decaying limbs of oak.

Ravenel, Fung. Car. 3: *22*; Georgia, *Ravenel*; Florida, *Lloyd*, *Calkins*; Louisiana, *Langlois*; Missouri, *Demetrio*..

2. **Cerrenella coriacea** (B. & Rav.)

Irpex coriaceus B. & Rav. Grevillea **1**: 101. 1872.

Described from Ravenel's South Carolina collections on dead oak branches. According to Berkeley, this species was described by Léveillé from Bogota as *Hydnum trachyodon* (Ann. Sci. Nat. III. **5**: 302. 1846) and was likewise found by Wright in Cuba (*I. trachyodon* B. & C. Jour. Linn. Soc. Bot. **10**: 326. 1868.

South Carolina, *Ravenel*; Alabama, *Peters*; Iowa, *Holway*.

SPECIES INQUIRENDAE

Irpex pityreus B. & C. Described from small specimens collected by Bennett in Rhode Island.

11. **Nigroporus** gen. nov.

Type: *Polyporus vinosus* Berk. Ann. Mag. Nat. Hist. II. **9**: 196. 1852.

Hymenium annual, epixylous, dimidiate-sessile to flabelliform, glabrous: context dark-brown, firm, homogeneous; tubes short, slender, thin-walled, black: spores smooth, hyaline.

Nigroporus vinosus (Berk.)

Polyporus vinosus Berk. Ann. Mag. Nat. Hist. II. **9**: 196. 1852.

Described from plants collected in San Domingo. The species is easily recognized by its wine-colored context.

Cuba, *Wright*, *Earle & Underwood 1574*, *Earle & Murrill 139*.

12. CYCLOMYCETELLA Murr. Bull. Torrey Club **31**: 422. 1904

Type: *Cyclomycetella pavonia* (Hook.) Murr.

Hymenophore annual, tough, epixylous, sessile, anoderm, zonate: context thin, fibrous, brown; tubes short, thin-walled, mouths polygonal, becoming concentrically elongated in some species by the splitting of the radial walls: spores ellipsoidal, smooth, ferruginous.

Species: *C. pavonia* (Hook.) Murr. [see Bull. Torrey Club **31**: 422, 423. 1904].

13. INONOTUS Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 39. 1879

Type: *Inonotus cuticularis* (Bull.) Karst.

Inoderma Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 39. 1879. Not *Inoderma* S. F. Gray 1821.

Type: *Inoderma radiatum* (Sow.) Karst.

Inodermus Quél. Ench. Fung. 173. 1886.

Type: *Inodermus hispidus* (Bull.) Quél.

Phaeoporus Schroet. Krypt. Fl. Schles. **3**: 489. 1888.

Type: *Inonotus cuticularis* (Bull.) Karst.

Hymenophore annual, epixylous, sessile, dimidiate, simple or somewhat imbricate, variable in size; surface usually anoderm, brown, hairy or glabrous: context brown, thin and fibrous to spongy or corky; hymenium concolorous, often covered with whitish powder in youth, tubes small, thin-walled: spores smooth, light to dark brown.

Species: *I. hirsutus* (Scop.) Murr., *I. perplexus* (Peck) Murr., *I. dryophilus* (Berk.) Murr., *I. texanus* Murr., *I. jamaicensis* Murr., *I. corrosus* Murr., *I. Wilsonii* Murr., *I. pusillus* Murr., *I. radiatus* (Sow.) Karst., *I. amplectens* Murr., *I. fruticum* (B. & C.) Murr. [see Bull. Torrey Club **31**: 593–601. 1904].

14. PHAEOLUS Pat. Tax. Hymen. 86. 1900

Type: *Phaeolus Schweinitzii* (Fr.) Pat.

Romellia Murr. Bull. Torrey Club **31**: 338. 1904.

Type: *Romellia sistotremoides* (Alb. & Schw.) Murr.

Hymenophore large, irregular, annual, spongy to corky, epixylous; stipe simple, variously attached, wanting at times; surface of pileus anoderm, hispid: context ferruginous, tubes irregular, thin-walled: spores ellipsoidal, smooth, hyaline; cystidia none.

This genus was founded on **Phaeolus sistotremoides** (Alb. & Schw.) Murr. and twelve other species, the majority of which I do not consider congeneric with the type. When I published the genus *Romellia* I was ignorant of the fact that *Phaeolus* had been raised from the subgeneric rank assigned it in 1897 (Ann. Bot. Buitenz. First Suppl. 112).

Species: *P. sistotremoides* (Alb. & Schw.) Murr. [see Bull. Torrey Club **31**: 338–340. 1904].

15. COLTRICIELLA Murr. Bull. Torrey Club **31**: 348. 1904

Type: *Coltriciella dependens* (B. & C.) Murr.

Hymenophore small, annual, tough, epixylous; stipe attached to the vertex of the pileus; surface of the pileus anoderm, zonate: context spongy, fibrous, ferruginous, tubes angular, one-layered, dissepiments thin: spores ellipsoidal, smooth, ferruginous.

Species: *C. dependens* (B. & C.) Murr. [see Bull. Torrey Club **31**: 348. 1904].

16. COLTRICIA S. F. Gray, Nat. Arr. Brit. Pl. **1**: 644. 1821

Type: *Coltricia perennis* (L.) Murr.

Strilia S. F. Gray, Nat. Arr. Brit. Pl. **1**: 645. 1821.

Type: *Strilia cinnamomea* (Jacq.) S. F. Gray.

Pelloporus Quél. Ench. Fung. 166. 1886.

Type: *Pelloporus triqueter* (Secr.) Quél.

Mucronoporus Ell. & Ev. Jour. Myc. **5**: 28. *pl. 8.* 1889.

Type: *Mucronoporus tomentosus* (Fr.) Ell. & Ev.

Onnia Karst. Finlands Basidsv. 326. 1889.

Type: *Onnia circinata* (Fr.) Karst.

Xanthochrous Pat. Cat. Tun. 51. 1897.

Type: *Xanthochrous tomentosus* (Fr.) Pat.

Hymenophore annual, terrestrial or humus-loving, simple, small to medium, usually circular and central-stemmed; surface anoderm, brown, zonate or azonate: context brown, coriaceous to spongy; hymenium concolorous, covered with yellowish or whitish powder when young, tubes thin-walled, at length fimbriate: spores smooth, rounded, ferruginous, cystidia rarely present.

Species: *C. cinnamomea* (Jacq.) Murr., *C. perennis* (L.) Murr., *C. parvula* (Kl.) Murr., *C. tomentosa* (Fr.) Murr., *C. obesa* (Ell. & Ev.) Murr., *C. Memmingeri* Murr. [see Bull. Torrey Club **31**: 340–348. 1904].

Subfamily 2. FOMITEAE

Hymenophore large, woody, perennial, rarely small or annual; surface anoderm or encrusted, usually sulcate, sometimes varnished: context punky or woody, variously colored; tubes cylindrical, usually thick-walled: spores rounded, smooth or verrucose, hyaline or brown, cystidia frequently present, surface conidia-bearing in a few species: stipe rarely present, the hymenophore usually being sufficiently elevated by its host.

Annual forms and species in a few genera connect this group with the *Polyporeae;* while the tendency at times to produce a daedaleoid hymenium, shown especially in *Porodaedalea*, connects it with the *Agariceae.*

Synopsis of the Fomiteae with brown context

- Surface of the hymenophore covered with reddish-brown varnish, context corky. 1. *Ganoderma.*
- Surface of the hymenophore not as above.
  - Context olivaceous. 2. *Fomitella.*
  - Context brown or dark-red.
    - Hymenophore plainly stipitate, simple. 3. *Amauroderma.*
    - Hymenophore subsessile, cespitose, arising from a common trunk or tubercle. 4. *Globifomes.*
    - Hymenophore truly sessile, dimidiate or ungulate, simple or imbricate.
      - Hymenium labyrinthiform, varying to porose, tubes not distinctly stratified. 5. *Porodaedalea.*
      - Hymenium porose, tubes distinctly stratified.
        - Pileus covered with a horny crust, context punky. 6. *Elfvingia.*
        - Pileus not covered with a horny crust, or, if encrusted, context woody. 7. *Pyropolyporus.*
  - Context dark-purple or black. 8. *Nigrofomes.*

1. GANODERMA Karst. Rev. Myc. **3**: 17. 1881

Type: *Ganoderma flabelliforme* (Scop.) Murr.

Placodes Quél. Ench. Fung. 170. 1886.

Type: *Ganoderma flabelliforme* (Scop.) Murr.

Hymenophore large, sessile or stipitate, perennial or annual, epixylous; surface sulcate, covered with reddish-brown varnish: context punky, brown, rarely pallid; tubes cylindrical, concolorous: spores ovoid, brown.

Species: *G. Tsugae* Murr., *G. flabelliforme* (Scop.) Murr., *G. sessile* Murr., *G. parvulum* Murr., *G. Oerstedii* (Fr.) Murr., *G. zonatum* Murr., *G. sulcatum* Murr., *G. nutans* (Fr.) Pat. [see Bull. Torrey Club **29**: 599–608. 1902].

2. **Fomitella** gen. nov.

Type: **Fomitella supina** (Sw.) Murr. (*Boletus supinus* Sw. Fl. Occ. Ind. **3**: 1926. 1806).

Hymenium sessile, at times semi-resupinate, applanate, epixylous; surface glabrous, anoderm to encrusted, sulcate with age: context woody or slightly punky, brownish-olivaceous, rarely varying to pallid; tubes minute, cylindrical, usually thick-walled, rarely stratose: spores smooth, hyaline.

Fomitella supina (Sw.)

Boletus resupinatus Sw. Prod. 149. 1788. Not *B. resupinatus* Fl. Dan. *pl. 844.*

Boletus supinus Sw. Fl. Occ. Ind. **3**: 1926. 1806.

Polyporus valenzuelianus Mont. Pl. Cell. Cuba 398. *pl. 15. f. 4.* 1842.

Polyporus guadelupensis Lév. Ann. Sci. Nat. Bot. III. **5**: 134. 1846.

Polyporus hemileucus B. & C. Jour. Linn. Soc. Bot. **10**: 312. 1868.

Polyporus plebeius cubensis B. & C. Jour. Linn. Soc. Bot. **10**: 313. 1868.

The brief description originally given of this species in the Prodromus is slightly changed and much enlarged by the author in his Flora of the West Indies. He had in the meantime discovered that the plant is not always resupinate and that the earlier name was preoccupied. The habitat is here given as "Trunks of old trees in the mountains of Jamaica."

Montagne's description is characteristically complete and is accompanied by excellent figures. In commenting upon Berkeley's opinion that *P. valenzuelianus* is identical with *P. supinus* of Swartz, Montagne says that, if it is that species Swartz' name is "thoroughly inappropriate and repugnant." He then quotes Fries' comment in Novae Symbolae to the effect that the two species differ decidedly in color.

Only one specimen of *P. valenzuelianus*, so named, is to be found at Kew from the West Indies. The others are all from South Carolina and Georgia. In the United States, specimens have usually been determined as *P. hemileucus* B. & C., described originally from Cuba and identical with *P. valenzuelianus* and *P. supinus.*

Types of *P. plebeius cubensis* also agree with the above, though the specimens are older and more or less encrusted with a dark purplish covering.

Few polypores are more common in Cuba than this one and a good series of specimens showing nearly all known variations may often be picked from one log. There are, however, in the collection here some plants from Florida which show two variations not yet seen in specimens from elsewhere. Some of these have the context and pores nearly white, instead of olive-colored, and others show distinctly daedaleoid variations in the hymenium. How much the steam treatment used by Calkins may have affected these specimens it is difficult to say.

This species occurs on fallen deciduous wood throughout tropical America and the states bordering the gulf of Mexico, being found as far north as South Carolina.

Ell. & Ev. N. A. Fung. *1704;* Georgia, *Ravenel, Harper;* South Carolina, *Ravenel;* Alabama, *Earle, Baker, Underwood;* Louisiana, *Langlois, Lloyd;* Texas, *Hodson;* Florida, *Martin, Rau, Calkins, Rolfs, Ives;* Cuba, *Wright 252, Earle 153, Earle & Wilson 230, Earle & Underwood 588, 1123, 1501, 1525, Earle & Murrill 107, 205, 224, 230, 255, 342, 358, 360, 370, 483, 527, 593;* Porto Rico, *Earle 169, 171;* Jamaica, *Underwood 2324, 2832, 2835, Earle 245 a;* Nicaragua, *C. L. Smith 74.*

3. **Amauroderma** gen. nov.

Type: **Amauroderma regulicolor** (Cke.) Murr.

Hymenophore large, epixylous, stipitate, the stipe often much elongated; surface smooth, encrusted, not varnished: context brown, punky; tubes cylindrical, concolorous, the mouths usually light-colored at first: spores ovoid or globose, brown.

The generic name here employed was used by Patouillard (Tax. Hymen. 105. 1900) for a subdivision of the genus *Ganoderma*, referring to the *dark*, namely, *not shining*, surface of certain species. Members of the genus within our limits are confined to the tropics.

Synopsis of the North American species

1.	Pileus less than 5 cm. in diameter, simple, tubes 8 to a mm.	1. *A. regulicolor.*
	Pileus 10 cm. or more in diameter.	2.
2.	Stipe laterally attached, plants cespitose, tubes 5 to a mm.	2. *A. coffeatum.*
	Stipe centrally attached, plants simple, spores spherical, echinulate.	3. *A. Chaperi.*

1. **Amauroderma regulicolor** (Cooke)

Fomes regulicolor Cooke, Grevillea **15**: 21. 1886.

This species occurs on decaying roots in Cuba, but is probably rare, being known only from the original collections.

2. **Amauroderma coffeatum** (Berk.)

Polyporus coffeatus Berk. Ann. Nat. Hist. **3**: 385. 1839.

Described from Guilding's collections in the island of St. Vincent. The species grows on decaying trunks, and is known only from the type locality.

3. **Amauroderma Chaperi** (Pat.)

Ganoderma Chaperi Pat. Jour. Botanique **4**: 197. 1890.

Described from plants collected by Chaper in Cuba and deposited in the herbarium at Paris.

4. GLOBIFOMES Murr. Bull. Torrey Club **31**: 424. 1904.

Type: *Globifomes graveolens* (Schw.) Murr.

Hymenophore large, woody, encrusted, perennial, epixylous, compound: context ferruginous, punky; tubes cylindrical, thick-walled, stratose: spores ovoid, smooth, ferruginous.

Species: *G. graveolens* (Schw.) Murr. *l. c.*

5. **Porodaedalea** gen. nov.

Type **Porodaedalea Pini** (Thore) Murr.

Hymenophore large, perennial, epixylous, sessile, conchate to ungulate; surface anoderm, sulcate, usually rough: context brown and woody; tubes concolorous, rarely in distinct layers, the hymenium varying from porose to daedaleoid: spores smooth, hyaline at maturity, becoming brownish with age, cystidia conspicuous.

Porodaedalea Pini (Thore)

Boletus Pini Thore, Chlor. Land. 487. 1803. Brot. Fl. Lusit. **2**: 468. 1804.

Daedalea Pini Fr. Syst. Myc. **1**: 336. 1821; Linnaea **5**: 514. 1830.

Polyporus Pini Pers. Myc. Eur. **2**: 83. 1825.

Fomes Abietis Karst. Bidr. Finlands Nat. och Folk **37**: 242. 1882.

Polyporus piceinus Peck, Rept. N. Y. State Mus. Nat. Hist. **42**: 25. 1889.

Trametes Pini Abietis Karst. Finlands Basidsv. 336. 1889.

This abundant and variable species was transferred to *Mucronoporus* by Ellis on account of its spiny hymenium, but it is best known as a *Trametes*. Besides its published specific names several manuscript names have been assigned to it, among which are *Polyporus gausapatus* Berk. & Rav. on pine, *Daedalea vorax* Harkness on *Abies Douglasii* in California and *Daedalea vetusta* Ell. & Hark., on white cedar in New Jersey.

It seems that this plant is more sensitive to changes in host than almost any other of its kind. One would expect a parasitic species like this to show more variation than an ordinary deadwood species, but the forms here assumed on different hosts and even on the same host under different conditions are surprising. I am supposing that the range of forms found on pine, spruce and other conifers represent a single species. They have all seemed so to me, and Dr. Schrenk expects shortly to prove their identity by the completion of a series of inoculation experiments covering various hosts.

The present species is too well known throughout both Europe and America as a destructive parasite of coniferous trees to require a list of specimens collected. All published exsiccati covering the group contain it and fresh material may be gathered in almost any locality.

6. ELFVINGIA Karst. Finlands Basidsv. 333. 1889.

Type: *Elfvingia lipsiensis* (Batsch) Murr.

Xylopilus Karst. Bidr. Finlands Nat. och Folk **37**: 69. 1882.

Type: *Xylopilus crassus* (Fr.) Karst.

Hymenophore large, epixylous, sessile, applanate or ungulate; surface sulcate, horny-encrusted: context brown, punky; tubes brown, cylindrical, stratose, thick-walled, mouths whitish when young: spores brown, rarely hyaline; conidia present in most species on the surface of the pileus.

Species: *E. fomentaria* (L.) Murr., *E. fasciata* (Sw.) Murr., *E. reniformis* (Morg.) Murr., *E. megaloma* (Lév.) Murr., *E. tornata* (Pers.) Murr., *E. Lionnetii* (Rolland) Murr. [see Bull. Torrey Club **30**: 296-301. 1903].

An examination of Schweinitz' type has shown his *Polyporus lobatus* to be a somewhat distorted form of *Elfvingia reniformis*. *P. lobatus* Schw. is not tenable, however, because of *P. lobatus* Schrad.

7. PYROPOLYPORUS Murr. Bull. Torrey Club **30**: 109. 1903.

Type: *Boletus igniarius* L.

Mison Adans. Fam. **2**: 10. 1763. Not associable with a binomial species.

Type: *Boletus igniarius* L. (Micheli's *pl. 62*).

Agaricon Adans. Fam. **2**: 10. 1763. Not *Agaricus* L. 1753.

Type: *Boletus igniarius* L. (Tournefort's *pl. 333*).

Phellinus Quél. Ench. Fung. 172. 1886. Not *Pheline* Poir. 1826.

Type: *Boletus igniarius* L.

Hymenophore large, perennial, epixylous, sessile, ungulate or applanate; surface sulcate, usually anoderm and often rough or rimose: context woody or punky, brown, rarely dark-red; tubes brown, cylindrical, stratose, usually thick-walled: spores smooth, ferruginous, rarely hyaline.

Species: *P. igniarius* (L.) Murr., *P. fulvus* (Scop.) Murr., *P. crustosus* Murr., *P. Calkinsii* Murr., *P. Everhartii* (Ell. & Gall.) Murr., *P. Robiniae* Murr., *P. praerimosus* Murr., *P. Underwoodii* Murr., *P. juniperinus* (Schrenk) Murr., *P. Earlei* Murr., *P. conchatus* (Pers.) Murr., *P. Haematoxyli* Murr., *P. Langloisii* Murr., *P. Ribis* (Schum.) Murr., *P. yucatanensis* Murr., *P. senex* (Nees & Mont.) Murr., *P. linteus* (B. & C.) Murr., *P. jamaicensis* Murr. [see Bull. Torrey Club **30**: 109–120. 1903].

8. NIGROFOMES Murr. Bull. Torrey Club **31**: 425. 1904.

Type: *Nigrofomes melanoporus* (Mont.) Murr.

Hymenophore large, perennial, epixylous, sessile: context woody, purple; tubes cylindrical, stratose, thick-walled, black: spores ovoid, smooth, hyaline.

Species: *N. melanoporus* (Mont.) Murr. *l. c.*

Subfamily 3. AGARICEAE

Hymenium annual, very rarely perennial, coriaceous to woody, variable in size; surface anoderm, hairy or glabrous, variously marked: context white or brown, fibrous, woody or punky; hymenium exceedingly variable, normally labyrinthiform or lamelloid, but often poroid or even irpiciform, never stratified: spores smooth, brown or hyaline.

Poroid and irpiciform plants of this group are difficult to separate from certain species of the *Polyporeae*; forms of *Agaricus confragosus* in particular being troublesome to the beginner. On the other hand, there is little to cause confusion between this group and the *Fomiteae*, if we except the single distinctly perennial species of *Agaricus*.and the daedaleoid forms of *Porodaedalea*.

Synopsis of the Agariceae with brown context

Hymenophore sessile, furrows radiate.	1. *Gloeophyllum*.
Hymenophore stipitate, furrows concentric.	2. *Cycloporus*.

1. GLOEOPHYLLUM Karst. Bidr. Finlands Nat. och Folk **37**: x, 79. 1882

Type: *Sesia hirsuta* (Schaeff.) Murr.

Sesia Adans. Fam. **2**: 10. 1763. Not associable with a binomial species.

Type: *Sesia hirsuta* (Schaeff.) Murr.

Serda Adans. Fam. **2**: 11. 1763. Not associable with a binomial species.

Type: *Sesia hirsuta* (Schaeff.) Murr.

Lenzitina Karst. Finlands Basidsv. 337. 1889.

Type: *Sesia hirsuta* (Schaeff.) Murr.

Hymenophore small, annual, epixylous, sessile; surface hairy or glabrous, anoderm, often zonate: context tough, brown; hymenium normally lamelloid or daedaleoid, but frequently poroid in some species: spores smooth, hyaline.

According to the rules now followed by most American botanists *Sesia* must be replaced by *Gloeophyllum*, as follows:

Species: *Gloeophyllum hirsutum* (Schaeff.) Murr., **Gloeophyllum Berkeleyi** (Sacc.) Murr., **Gloeophyllum striatum** (Sw.) Murr., **Gloeophyllum pallidofulvum** (Berk.) Murr. [see Bull. Torrey Club **31**: 602–606. 1904].

2. CYCLOPORUS Murr. Bull. Torrey Club **31**: 423. 1904

Type: *Cycloporus Greenei* (Berk.) Murr.

Hymenophore annual, tough, anoderm, terrestrial, centrally stipitate: context soft, spongy, ferruginous; pores at first polygonal, soon becoming continuous concentric furrows, dissepiments thin, lamelloid: spores ovoid, smooth, ferruginous.

In publishing the above genus I neglected to state that the name had been previously used by Patouillard for a subgenus of his genus *Xanthochrous* (Ann. Bot. Buitenz. First Suppl. 113. 1897).

Species: *C. Greenei* (Berk.) Murr. *l. c.*

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THE POLYPORACEAE OF NORTH AMERICA—XII

A SYNOPSIS OF THE WHITE AND BRIGHT-COLORED PILEATE SPECIES

By WILLIAM ALPHONSO MURRILL

NEW YORK
1905

[From the BULLETIN OF THE TORREY BOTANICAL CLUB 32: 469-493. 1905]

[From the Bulletin of the Torrey Botanical Club, 32 : 469-493 1905,]

The Polyporaceae of North America — XII. A synopsis of the white and bright-colored pileate species

William Alphonso Murrill

A synopsis of species with brown context was given in article XI of this series. The present paper deals with the genera and the principal described species having a white or bright-colored context and a distinct pileus. The species of certain genera are so numerous that they must form the subject of a separate article.

Subfamily 1. POLYPOREAE

It is not always possible to draw a distinct line of cleavage in this group. *Microporellus*, for example, has sessile forms which are thin and multizonate; *Funalia*, while usually brown, has some nearly white variations, and *Polyporus arcularius*, *Polyporus Polyporus* and *Polyporus caudicinus* have tubes very similar to those of *Hexagona.*

In distinguishing the subfamilies, also, certain species of *Fomes* are annual at times, while normally annual plants may assume a perennial appearance under favorable conditions. Poroid forms of *Agaricus* are always liable to confuse the beginner. The classification here adopted is acknowledged to be imperfect and artificial, but it is hoped that it will lead to something better when our knowledge of the plants treated is more complete.

Synopsis of the Polyporeae with white context

Hymenophore sessile.
Tubes hexagonal, arranged in radiating rows; context thin. 1. *Hexagona.*
Tubes alveolar; context thin, dry, surface zonate. 2. *Favolus.*
Tubes mostly shallow, marginal and obsolete; hymenium hydnoid or irpiciform at a very early stage. 3. *Irpiciporus.*
Tubes normally poroid, sometimes irpiciform from the rupture of the dissepiments at maturity.
Hymenium at length separating smoothly from the context. 4. *Piptoporus.*
Hymenium not separating as above.
Pileus very soft, spongy and elastic throughout.
Hymenophore of immense size; tubes small, fragile when dry. 5. *Dendrophagus.*
Hymenophore small; tubes large, not fragile. 6. *Spongiporus.*

- Pileus more or less firm, flexible or rigid.
  - Context duplex, spongy above, firm below; surface sodden and bibulous. 7. *Spongipellis.*
  - Context not duplex as above.
    - Pileus fleshy-tough to woody and rigid; surface rarely zonate.
      - Surface anoderm.
        - Hymenium more or less smoke-colored at maturity. 8. *Bjerkandera.*
        - Hymenium white or pallid.
          - Context fleshy to fleshy-tough, friable when dry. 9. *Tyromyces.*
          - Context punky to corky, not friable when dry. 10. *Trametes.*
      - Surface pelliculose; plants chiefly tropical.
        - Plants small, 5 cm. or less in diameter. 11. *Rigidoporus.*
        - Plants large, more than 5 cm. in diameter.
          - Hymenium flesh-colored. 12. *Earliella.*
          - Hymenium white or pallid. 13. *Cubamyces.*
    - Pileus thin, leathery and more or less flexible; surface usually zonate.
      - Hymenophore preceded by a cup-shaped sterile body. 14. *Poronidulus.*
      - Hymenophore not as above.
        - Hymenophore normally pileate; tubes small and regular. 15. *Coriolus.*
        - Hymenophore semi-resupinate; tubes irregular. 16. *Coriolellus.*

- Hymenophore stipitate.
  - Stipe compound. 17. *Grifola.*
  - Stipe simple.
    - Plants fleshy, terrestrial. 18. *Scutiger.*
    - Plants tough, epixylous.
      - Tubes large, hexagonal and radially elongated from the first. 1. *Hexagona.*
      - Tubes not as above.
        - Pileus inverted, erumpent from lenticels. 19. *Porodiscus.*
        - Pileus erect or lateral, not erumpent.
          - Context duplex, spongy above, woody below. 20. *Abortiporus.*
          - Context homogeneous, firm.
            - Surface zonate. 21. *Microporellus.*
            - Surface azonate. 22. *Polyporus.*

1. HEXAGONA Pollini, Pl. Nov. 35. *pl. 2, 3.* 1816

Type: *Hexagona Mori* Pollini.

Hymenophore small, annual, epixylous, flabelliform to reniform, rarely circular, stipitate, the stipe sometimes much reduced;

surface smooth or tessellated, margin thin; context thin, white, fibrous, fleshy to tough, usually fragile when dry; hymenium of radiating rows of large, thin-walled, hexagonal tubes, usually radially elongated; spores smooth, hyaline.

Species: *H. alveolaris* (DC.) Murr., *H. micropora* Murr., *H. daedalea* (Link) Murr., *H. Wilsonii* Murr., *H. hispidula* (B. & C.) Murr., *H. princeps* (B. & C.) Murr., *H. fragilis* Murr., *H. floridana* Murr., *H. tessellatula* Murr., *H. caperata* (Pat.) Murr., *H. brunneola* (B. & C.) Murr., *H. purpurascens* (B. & C.) Murr., *H. portoricensis* Murr., *H. hondurensis* Murr., *H. indurata* (Berk.) Murr., *H. cucullata* (Mont.) Murr., *H. Taxodii* Murr. [See Bull. Torrey Club **31**: 325–333. 1904.]

2. FAVOLUS Beauv. Fl. Owar. **1**: 1. *pl. 1.* 1805

Type: *Favolus hirtus* Beauv.

Scenidium Kuntze, Rev. Gen. 515. 1893. Type: *Favolus hirtus* Beauv.

Hymenophore small, annual, epixylous, sessile, dimidiate or reniform; surface multizonate, margin thin; context thin, leathery, pallid or brown; tubes alveolar; spores smooth, hyaline.

Species: *F. tenuis* (Hook.) Murr., *F. variegatus* (Berk.) Murr. [See Bull. Torrey Club **32**: 99–103. 1905.] The first species is usually white in substance, the other brown.

3. **Irpiciporus** gen. nov.

Type: *Irpex mollis* B. & C.

Hymenophore annual, epixylous, sessile, effused-reflexed, white or pallid throughout; surface anoderm, glabrous or velvety, not distinctly zonate, margin acute; context white, coriaceous or corky; hymenium hydnoid or irpiciform with traces of shallow obsolete tubes near the margin; spores smooth, hyaline.

Synopsis of the North American species

Teeth a centimeter or more in length; pileus often large and thick. *I. mollis.*
Teeth one-half a centimeter or less in length; pileus thin and shortly reflexed. *I. Tulipiferae.*

Irpiciporus mollis (B. & C.)

Irpex mollis B. & C. Hook. Jour. Bot. **1**: 236. 1849.

Irpex crassus B. & C. Hook. Jour. Bot. **1**: 236. 1849.

Described under the former name from Ravenel's collections in South Carolina and under the latter lower down on the same page from plants collected by Curtis high up on the trunk of a living oak in North Carolina. The distinct zones on the context appear to accompany luxuriant growth, being present in very large plants known by Berkeley as *I. crassus.*

This species is often met with upon decaying wood of oak, locust, apple and various other deciduous trees throughout temperate North America.

New York, *Cook;* New Jersey, *Ellis;* Virginia, *Murrill;* Georgia, *Harper;* Florida, *Calkins, Lloyd;* Ohio, *Morgan;* Michigan, *Pieters.*

Irpiciporus Tulipiferae (Schw.)

Boletus Tulipiferae Schw. Syn. Fung. Car. 73. 1818.
Irpex Tulipiferae Fr. Epicr. 523. 1838.

Described from Schweinitz' Carolina collections on dead trunks of *Liriodendron,* as follows:

"B. P. maxima effusa margine involuto tenui albida, poris maximis acutis prominulis asperis irregularibus."

This species is considered by many the same as *I. sinuosus* Fr. (Elench. Fung. 145. 1828), described from specimens observed for several years on fallen oak branches in Sweden and others sent from Ruthenia by Weinmann. Bresadola goes further and adds *I. lacteus* Fr., *I. canescens* Fr. and *I. Bresadolae* Schulz. to the list of synonyms. In any case, Schweinitz' name is the oldest.

This is one of the commonest fungi in our woods, the thin effused pilei often extending the whole length of branches, and even entire trunks, of dead deciduous trees of all kinds. A few collections are as follows:

Canada, *Macoun;* New York, *Peck, Shear, Britton;* Pennsylvania, *Sumstine, Murrill;* New Jersey, *Ellis, Britton, Murrill;* Virginia, *Murrill;* Tennessee, *Murrill;* Ohio, *Selby, Morgan;* Missouri, *Demetrio;* Kansas, *Bartholomew;* Wisconsin, *Baker;* Mexico, *Egeling.*

SPECIES INQUIRENDAE

IRPEX PALLESCENS Fr. Epicr. 522. 1838. Described from plants collected by Schweinitz in North America on trunks of *Liriodendron.*

4. PIPTOPORUS Karst. Rev. Myc. 3^9: 17. 1881

Type: *Boletus betulinus* Bull.

Hymenophore annual, epixylous, umbonate-sessile; surface smooth, azonate, pelliculose; context white, fleshy-tough; hymenium at length separating smoothly from the context, tubes white, thick-walled; spores smooth, cylindrical, hyaline.

Species: *P. suberosus* (L.) Murr. [See Bull. Torrey Club 30: 424, 425. 1903.]

5. **Dendrophagus** gen. nov.

Type: *Polyporus Colossus* Fr.

Hymenophore very large, but of light weight, annual, epixylous, sessile, dimidiate, thick and pulvinate; surface pelliculose, glabrous, azonate, margin very obtuse; context very thick, soft and spongy throughout; tubes small, dark-colored, thin-walled, fragile; spores smooth, hyaline.

Dendrophagus Colossus (Fr.)

Polyporus Colossus Fr. Nov.-Symb. 56. 1851.

Described from material collected by Oersted on stumps of *Cedrela odorata* at Puntarena in Costa Rica as follows:

"Pileo floccoso-suberoso molli crasso pulvinato, *margine tumido obtusissimo*, primitus cuticula tenella laevi vernicea sulfurea tecto, eaque secedente scabroso, contextu stuppeo mollissimo alutaceo-pallescente, poris minutis elongatis mollibus, intus fuscescentibus."

"Portentum mirabile et magnitudine et ponderis levitate. Fungus dimidiatus, sessilis, reniformis sed undulatus, crassimus (3–4 unc.) etiam in margine obtusissimo, contextu stuppeo-fomentario (nullo modo fibroso ut in Spongiosis), mollissima, alutaceo-pallida l. isabellina. Pileus extus quoque mollissimus, ut digito pressus foveas relinquat persistentes, undulatus, more *P. betulini* tectus cuticula laevi vernicea arcte adnata citrina, et in hoc statu pileus politus apparet, at cuticula secedente scabrosus evadit et decolorans. Pori valde longi et densi, absque trama discolori et a pileo separabiles, ore minuto, exsiccati nigrescentes, intus fuscescentes; in vivo enim admodum molles et hinc in exsiccatis confluunt in callum nigricantem absque poris extus conspicuis. Ad truncos ins. *San Jan* Indiae occid. lectus est fungus aeque giganteus, textura eadem, modo obscurior et pondere gravior; sed pileus epelliculosus, scabrosus, nigrescens. Pro forma prioris exoleta habeo."

Plants collected by Millspaugh, *no. 57838*, in Yucatan, appear to be immature specimens of the above species. Oersted's original plants are still preserved at Upsala. Further tropical exploration will doubtless discover more of this remarkable species.

6. **Spongiporus** gen. nov.

Type: *Polyporus leucospongia* Cooke & Hark.

Hymenophore small, annual, epixylous, sessile, dimidiate, pulvinate; surface white, anoderm to subpelliculose, azonate, soft and elastic; context white, extremely soft and spongy throughout; hymenium rigid, somewhat discolored, tubes large, irregular, thin-walled, lacerate; spores smooth, hyaline.

Spongiporus leucospongia (Cooke & Hark.)

Polyporus leucospongia Cooke & Hark. Grevillea **11**: 106. 1883.

This species was described from plants collected by Harkness at an altitude of 2,400 meters in the Sierra Nevada Mts., California, in 1882, growing upon decaying pine and spruce logs. Plants sent to Ellis under the name of *P. labyrinthicus* Schw. were forwarded to Cooke, who said they were clearly not *P. labyrinthicus* and suggested that they be described as new under the name of *Polyporus leucospongia*, an eminently appropriate name, since the whole pileus is pure white and as soft as a delicate sponge when young. Specimens have since been several times collected in Colorado by Bethel at about 3,600 meters on coniferous logs projecting from the snow. In such localities, he says, the plant is common, covering the ends of all such projecting logs. Crandall has also found it in Colorado and Nelson in Wyoming.

In Saccardo's Sylloge this species is queerly mixed with *P. labyrinthicus*, an error which clearly originated at Kew, for the sheet containing specimens of *P. labyrinthicus* labeled "U. S., C. B. Plowright" contains also at the bottom two packets of *P. leucospongia* from Harkness, *no. 1012*, collected in California on *Pinus contorta* and sent, as we know, under the name of *P. labyrinthicus*.

7. SPONGIPELLIS Pat. Hymén. Europ. 140. 1887

Type: *Spongipellis spumeus* (Sow.) Pat.

Postia Karst. Rev. Myc. 3^9: 17. 1881. (Not *Postia* Boiss. & Blanch. 1875.) Type: *Polyporus borealis* Fr.

Hymenophore annual, epixylous, sessile, dimidiate, simple or imbricate, rather large; surface white, anoderm, sodden and bibulous; context white, duplex, spongy above, firm below; hymenium concolorous, tubes thin-walled; spores smooth, hyaline.

Synopsis of the North American species

Context coarsely fibrous; tubes medium; plant common on coniferous wood. *S. borealis.*

Context finer; tubes smaller; plant found on deciduous wood. *S. galactinus.*

SPONGIPELLIS BOREALIS (Fr.) Pat. Tax. Hymén. 84. 1900

Polyporus borealis Fr. Syst. Myc. **1**: 366. 1821.

Described from material collected on trunks of *Abies* in the mountains of Smoland as follows:

"P. albus, pileis fibroso-suberosis mollibus subvillosis, demum subfulventibus, poris tenuibus inaequalibus.

"Recens inodorus, siccus odorem aniseum debilem spargit. Imbricatus, subconcrescens, 2 unc. & ultra latus & crassus, superne convexus, nunc velutinus, nunc strigosus, margine acuto, subtus planus. Pori albi, lacerati, sinuoso & subrotundi, angustissimi, tubulos longos formant."

In the Elenchus, Fries separates two varieties, *montanus* and *spathulatus*, and notes that the species is extremely abundant on fir trunks in the mountains of Omberg.

This plant, although well known in Europe and fairly common in the northern parts of America, is still very imperfectly known by many of the botanists and most of the collectors in this country. It occurs on coniferous trees only, being found most frequently in America on the hemlock. Much more needs to be learned of its distribution. From what is known of it in Europe, one would expect to find it throughout North America as far south as Virginia, but American collections are very meager, as the following will show:

Finland, *Karsten;* Sweden, *Romell;* Germany, *Allescher;* Tyrol, *Bresadola;* Scotland, *Berkeley;* Canada, *Dearness;* New York, *Cook*, *Atkinson*, *Murrill*, *Mrs. Livingston;* Pennsylvania, *Gentry*, *Stevenson.*

SPONGIPELLIS GALACTINUS (Berk.) Pat. Tax. Hymén. 84. 1900

Polyporus galactinus Berk. Lond. Jour. Bot. **6**: 321. 1847.

Collected by Lea on rotten trunks near Waynesville, Ohio, in the autumn of 1844 and thus described by Berkeley:

"Pileus 2–3 inches broad, 1½ inch long, dimidiate or reniform, and elongated behind, convex uneven, milk-white, clothed with strigose down of a soft, fleshy substance, zoned within and consisting of radiating fibers.

"Hymenium flat, or slightly concave. Pores $\frac{1}{100}$ of an inch broad, scarcely visible to the naked eye, but giving to the hymenium a silky lustre, white; dissepiments very thin, slightly uneven.

"Nearly allied to *Pol. undulatus* Schwein, and *Pol. symphyton* Schwein. The dried specimens are rigid, and sometimes have the margin dark brown."

This species was determined by Cooke as *P. borealis* and is usually seen under that name in collections. It may be distinguished by its smaller tubes, its less fibrous context and its habit of growing on deciduous instead of coniferous trees. One of its favorite hosts is the apple-tree, on which it has several times been found in New York and Connecticut, growing inside partially decayed trunks or emerging from knot-holes in living trees. When fresh it is pure white or watery white and so full of water that this may be squeezed out as from a sponge. On drying, it usually assumes a sordid tint, especially near the margin.

Specimens are at hand from Canada, *Dearness;* Massachusetts, *Underwood;* Connecticut, *Earle, Miss White;* New York, *Underwood, Earle, Stewart, Peck, Banker;* Delaware, *Commons;* Ohio, *Morgan, Lloyd.*

SPECIES INQUIRENDAE

BOLETUS UNDULATUS Schw. Syn. Fung. Car. 70. 1818. *Polyporus undulatus* Fr. Elench. Fung. 87. 1828. Described by Schweinitz from Carolina as follows:

"B. major subimbricatus spongiosus lutescens, pileo undulato hirto margine zonato, poris minutis candidis. Elegans fungus ad truncos rarius occurrit, in longitudinem expansus, interdum fere substipitatus, aetate indurescens. Pileus basi incrassatus, strigoso hirtus, margine substrigosus."

Fries makes the following comments on this species in the Elenchus:

"Major in longitudinem extensus, interdum postice porrectus, junior spongiosus, aetate indurescens. Pilei basi incrassati, strigoso-hirti ex Auctore, sed in meo Specimine tantum rugosi et quoad colorem fumosi. Pori minuti, obtusi, integri, in meo specimine sordidi. Caro crassa, fibrosa, subzonata, albida. Mihi *P. fumoso* proximus visus indeque hoc loco collocatus."

TRAMETES MALICOLA B. & C. Jour. Acad. Sci. Phila. II. **3**: 209. 1856. Described from specimens collected by Schweinitz on the trunk of an apple-tree at Bethlehem, Pennsylvania, and determined by him as *P. populinus* Fr., being *no. 366* in his synopsis. When his herbarium was examined by Berkeley and Curtis, this species was described as new as follows:

"Imbricatus, ligneus; pileis dimidiatis posticé decurrentibus subvillosis subzonatis, ligneo-umbrinis; poris mediis dissepimentis crassis subtomentosis."

8. BJERKANDERA Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 38. 1879

Type: *Polyporus adustus* Fr.

Merisma Gill. Champ. Fr. **1**: 688. 1878. (Not *Merisma* Persoon.) Type: *Boletus imberbis* Bull.

Myriadoporus Peck, Bull. Torrey Club **11**: 27. 1884. Type: *Myriadoporus adustus* Peck.

Hymenophore annual, epixylous, sessile, anoderm, glabrous, azonate, corky; context white, tough or woody, not friable when dry; tubes thin-walled, more or less smoke-colored, mouths polygonal; spores smooth, hyaline.

The species of *Bjerkandera* will be treated in a future paper.

9. TYROMYCES Karst. Rev. Myc. 3^9: 17. 1881

Type: *Polyporus chioneus* Fr.

Leptoporus Quél. Ench. Fung. 175. 1886. (Not *Leptopora* Raf. 1809.) Type: *Polyporus tephroleucus* Fr.

Oligoporus Bref. Unters. **8**: 114. *pl. 7. f. 12–22.* 1889. Type: *Oligoporus farinosus* Bref.

Hymenophore annual, epixylous, sessile, anoderm, azonate, glabrous or nearly so; context white, fibrous, fleshy to fleshy-tough, rigid and friable when dry; tubes thin-walled, white or yellowish, mouths polygonal; spores smooth, hyaline.

The species of *Tyromyces* will be treated in a later number of this series.

10. TRAMETES Fr. Gen. Hymen. 11. 1836.

Type: *Polyporus suaveolens* L.

Hymenophore annual, epixylous, sessile; surface anoderm, white, azonate; context white, homogeneous, coriaceous to soft-corky; hymenium concolorous, rigid, tubes thin-walled, mouths circular to irregular; spores smooth, hyaline.

The species of this genus will be considered in a later paper.

11. **Rigidoporus** gen. nov.

Type: *Polyporus micromegas* Mont.

Hymenophore annual, at times reviving, epixylous, sessile, dimidiate, conchate, simple or imbricate; surface pelliculose, multizonate, margin thin, incurved when dry; context thin, white, woody, very rigid when dry, tubes minute, regular, light-brown, mouths pruinose when young; spores smooth, hyaline.

Rigidoporus micromegas (Mont.)

Polyporus micromegas Mont. Pl. Cell. Cuba 423. 1842.
Polyporus plumbeus Lév. Ann. Sci. Nat. III. Bot. **5**: 136. 1846.
Polystictus rufopictus Cooke, Grevillea **15**: 23. 1886.

Besides the above names, assigned to Cuba and Guadeloupe specimens, there are several manuscript names and doubtless others in publication which refer to the same species.

This plant has been generally known under the name of *P. zonalis* Berk., described from König's Ceylon collections (Ann. Mag. Nat. Hist. **10**: Suppl. 375. *pl. 10. f. 5.* 1843). It is exceedingly common in tropical America and in the states bordering the Gulf of Mexico, occurring usually during wet weather on water-soaked logs of various species of palms and other broad-leaved trees. It is very rigid when dry and the pores are almost invisible. Some of the more recent collections are here mentioned.

Cuba, *Earle, Underwood, Murrill;* Jamaica, *Earle, Underwood;* Porto Rico, *Earle, Wilson;* Florida, *Ricker;* Louisiana, *Langlois;* Alabama, *Underwood, Earle.*

12. **Earliella** gen. nov.

Type: *Earliella cubensis* sp. nov.

Hymenophore medium to large, annual, epixylous, semi-resupinate, thin and dry but rigid; surface pelliculose, glabrous, zonate, more or less reddish-brown in color; context white, coriaceous, zonate; hymenium flesh-colored, tubes medium, irregular, becoming thin-walled; spores smooth, hyaline.

Earliella cubensis sp. nov.

Pileus annual, often reviving, semi-resupinate, laterally extended, conchate, imbricate, 3–6 × 5–15 × 0.2–0.5 cm.; surface thinly encrusted, glabrous, rugose, zonate, dark reddish-brown behind, or leaving a white marginal band 3–12 mm. in width; margin tumid, at length thin, undulate or lobed, fertile; context white, coriaceous, concentrically zonate; tubes 2–3 mm. long, 2–4 to a mm., white within, the mouths deep reddish-flesh-colored, fading to white, dissepiments at first thick, at length becoming thin and irregular with wavy edges; spores ellipsoidal, smooth, hyaline, 3–4 × 5–6 μ, cystidia none.

The type plants of this species were collected by Earle and Murrill (*no. 193*) near Herradura, Cuba, March 11, 1905. They grew on a decayed fallen deciduous log in rather moist woods. The species was collected also in the central and eastern parts of Cuba, and appears to be fairly well distributed and quite abundant in the island. It is known also from Jamaica and Central America. Berkeley identified the plant as *Polystictus Persoonii* Fr., which is the same as *Daedalea sanguinea* Kl. (Linnaea **8**: 481. 1833), described from Wight's collections in the East Indies. I have this latter plant from Hawaii, China, Africa and Australia, and there is a close resemblance between it and the American plant, but I think the two are sufficiently distinct. If *P. rudis* Lév. were better known it might prove to be an earlier name for the American species in question.

Cuba, *Earle & Murrill 104, 193, 204, 584;* Jamaica, *Earle 489;* Mexico, *C. L. Smith;* Nicaragua, *Shimek.*

SPECIES INQUIRENDAE

POLYPORUS RUDIS Lév. Ann. Sci. Nat. III. Bot. **5**: 133. 1846. *Polyporus subfulvus* Cooke, Trans. Bot. Soc. Edinburgh **13**: 153. 1878. Described from plants collected by Lherminier on trunks in the island of Guadeloupe as follows:

"Pileo coriaceo-suberoso applanato elongato sessili nudo e basi ad marginem acutum sinuosum rugoso-radiato concentrice sulcato, postice nigricante, antice fulvo, poris minutis rotundis ore obtusis fuscescentibus, intus contextuque fulvis."

This description may have been made from an old discolored specimen.

13. **Cubamyces** gen. nov.

Type: *Polyporus cubensis* Mont.

Hymenophore large, annual, epixylous, sessile, thin, dry, conchate; surface pelliculose, glabrous, normally azonate; context white or yellowish, thin, homogeneous, very soft and elastic; hymenium concolorous, tubes small and regular, rather thick-walled, firm and corky, mouths entire; spores smooth, hyaline.

Cubamyces cubensis (Mont.)

Polyporus cubensis Mont. Ann. Sci. Nat. II. Bot. **8**: 364. 1837; Pl. Cell. Cuba 404. *pl. 16. f. 3.* 1842.

Originally described from plants collected near Havana, Cuba, by Sagra. It seems especially abundant in Cuba, but occurs also in southern Florida and Central America.

Cuba, *Underwood & Earle 543, 544, 596, 1111, 1204, 1443, 1568, Earle & Murrill 140, 337, 534, 414*; Florida, *Lloyd*; Nicaragua, *Smith.*

SPECIES INQUIRENDAE

POLYPORUS HAVANNENSIS B. & C. Jour. Linn. Soc. Bot. **10**: 310. 1868. Described from specimens collected by Wright on dead wood in Cuba as follows:

"Pileo dimidiato convexo zonato fulvo-ochraceo e pubescente glabro radiato-ruguloso, margine leviter pulvinato sterili pubescente; hymenio pallido, poris parvis subrotundis acie obtusis. Pileus 2 inches wide, 1 inch long; pores $\frac{1}{100}$ inch in diameter. Allied to *P. anebus*, B[erk]., but with larger pores."

This species appears to be very near to *C. cubensis.*

14. PORONIDULUS Murr. Bull. Torrey Club **31**: 425. 1904

Type: *Boletus conchifer* Schw.

Hymenophore annual, tough, sessile, epixylous, at first sterile and cup-like, the fertile portion developing from the sterile; context white, fibrous, tubes short, thin-walled, mouths polygonal; spores ellipsoidal, smooth, hyaline.

Species: *P. conchifer* (Schw.) Murr. [See Bull. Torrey Club **31**: 425, 426. 1904.]

15. CORIOLUS Quél. Ench. Fung. 175. 1886.

Type: *Polyporus zonatus* Fr.

Hansenia Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 39. 1879. (Not *Hansenia* Turcz. 1844.) Type: *Boletus hirsutus* Wulf.

Hymenophore annual, epixylous, sessile, zonate, anoderm, hairy or glabrous; context thin, white, flexible, fibrous, leathery; tubes thin-walled, white, at length splitting into irpiciform teeth in several species, mouths polygonal or irregular; spores smooth, hyaline.

The species of this genus will be treated in a later number of this series.

16. **Coriolellus** gen. nov.

Type: *Trametes Sepium* Berk.

Hymenophore small, dry, annual, epixylous, semi-resupinate; surface white, anoderm, usually azonate; context white, thin, fibrous to corky; hymenium concolorous, tubes thin-walled, usually large and irregular, dentate, but not irpiciform; spores smooth, hyaline.

Coriolellus Sepium (Berk.)

Trametes Sepium Berk. Lond. Jour. Bot. **6**: 322. 1847.

Described from specimens collected by Lea on dry fence-rails in Ohio as follows:

"Pilei effused at the base, reflexed above, laterally connate, at first often attached by the vertex or triquetrous, pale wood-coloured, finely tomentose, marked with numerous darker zones. Hymenium pallid, consisting of slightly sinuous pores about $\frac{1}{30}$th of an inch in diameter."

This species occurs on various kinds of structural timber and other dead wood, especially of deciduous trees, throughout most of temperate North America. Oak and chestnut posts and poles with the bark removed frequently supply the sporophores in great numbers. Only a few collections are here mentioned:

Canada, *Macoun;* Connecticut, *Hanmer;* New York, *Underwood, Mrs. Livingston* and *Miss Crane;* New Jersey, *Ellis;* Virginia, *Murrill;* South Carolina, *Ravenel;* Tennessee, *Murrill;* Ohio, *Lloyd;* Kansas, *Cragin.*

17. GRIFOLA S. F. Gray, Nat. Arr. Brit. Pl. **1**: 643. 1821

Type: *Boletus frondosus* Dicks.

Polypilus Karst. Rev. Myc. 3^9: 17. 1881. Type: *Boletus frondosus* Schrank.

Meripilus Karst. Bidr. Findlands Nat. och Folk **37**: 33. 1882. Type: *Boletus giganteus* Pers.

Cladomeris Quél. Ench. Fung. 167. 1886. Type: *Polyporus umbellatus* Fr.

Hymenophore large, annual, stipitate, compound, intricately branched or lobed, humus-loving or epixylous, rarely terrestrial, usually found at the base of a tree-trunk; surface smooth, pallid to gray or brown; context white, fleshy or fleshy-tough, rigid and fragile when dry; tubes large, irregular, thin-walled, becoming friable or laciniate with age; spores hyaline, smooth, rarely verrucose.

Species: *G. poripes* (Fr.) Murr., *G. Sumstinei* Murr., *G. frondosa* (Dicks.) S. F. Gray, *G. ramosissima* (Scop.) Murr., *G. Berkeleyi* (Fr.) Murr., *G. fractipes* (B. & C.) Murr. [See Bull. Torrey Club **31**: 333–338. 1904].

18. SCUTIGER Paul. Icon. Champ. *pl. 31. f. 1–3.* 1793

Type: *Scutiger tuberosus* Paul.

Albatrellus S. F. Gray Nat. Arr. Brit. Pl. **1**: 645. 1821. Type: *Boletus albidus* Pers.

Caloporus Quél. Ench. Fung. 164. 1886. Type: *Boletus subsquamosus* L.

Hymenophore simple, terrestrial, annual, mesopous, usually bright-colored: surface anoderm, variously decorated; context white, rarely colored, fleshy to tough, rigid and fragile when dry; hymenium porose, white or colored, tubes thin-walled; spores smooth, hyaline.

Species: *S. Ellisii* (Berk.) Murr., *S. retipes* (Underw.) Murr., *S. decurrens* (Underw.) Murr., *S. cryptopus* (Ell. & Barth.) Murr., *S. laeticolor* Murr., *S. caeruleoporus* (Peck) Murr., *S. holocyaneus* (Atk.) Murr., *S. radicatus* (Schw.) Murr., *S. subradicatus* Murr., *S. griseus* (Peck) Murr., *S. persicinus* (B. & C.) Murr., *S. Whiteae* Murr. [See Bull. Torrey Club **30**: 425–432. 1903].

19. PORODISCUS Murr. Bull. Torrey Club **30**: 432. 1903

Type: *Peziza pendula* Schw.

Enslinia Fr. Summ. Veg. Scand. 399. 1849. (Not *Enslinia* Rchb. 1827.) Type: *Sphaeria pocula* Schw.

Hymenophore small, annual, tough, epixylous, erumpent from the lenticels of dead branches; stipe attached to the vertex of the pileus, usually curved at maturity; context white, fibrous, tubes cylindrical, short, one-layered, mouths constricted; spores globose, smooth, hyaline.

Species: *P. pendulus* (Schw.) Murr. [See Bull. Torrey Club **30**: 432–434. 1903].

20. ABORTIPORUS Murr. Bull. Torrey Club **31**: 421. 1904

Type: *Boletus distortus* Schw.

Hymenophore annual, tough, humus-loving; stipe normally central, often obsolete; context yellowish-white, duplex, spongy above, woody below, tubes thin-walled, mouths polygonal; spores subglobose, smooth, hyaline.

Species: *A. distortus* (Schw.) Murr. [See Bull. Torrey Club **31**: 421, 422. 1904].

21. **Microporellus** gen. nov.

Type: *Polyporus dealbatus* B. & C.

Hymenophore thin, annual, epixylous, usually flabelliform, stipitate, the stipe variously attached and sometimes much reduced; surface anoderm, multizonate; context thin, white, fibrous, rigid and fragile when dry; tubes very minute, regular, thin-walled, fragile when dry; spores smooth, hyaline.

Synopsis of the North American species

Plants white or pale brownish, the color not changing when dry.	*M. dealbatus.*
Plants lurid, becoming black when dry.	*M. holotephrus.*

Microporellus dealbatus (B. & C.)

Polyporus dealbatus B. & C. Ann. Mag. Nat. Hist. II. **12**: 432. 1853.

Polyporus mutabilis B. & C. Ann. Mag. Nat. Hist. II. **12**: 433. 1853.

Polyporus petaliformis B. & C. Jour. Linn. Soc. Bot. **10**: 307. 1868.

Polyporus polygrammus B. &. C. Jour. Linn. Soc. Bot. **10**: 307. 1868.

Polyporus Ravenelii B. & C. Grevillea **1**: 38. 1872. *Polystictus cretatus* Cooke, Trans. Bot. Soc. Edinburgh **13**: 137. 1878.

This remarkably variable plant was originally described from the collections of Curtis in South Carolina, and has since been published by the same authors under several different names. The types at Kew show abundant variations, but no good characters for specific separation. The species ranges southward to the West Indies and into South America, where it has doubtless received other names.

Collections are at hand from South Carolina, *Ravenel;* Georgia, *Ricker;* Florida, *Ravenel;* Louisiana, *Langlois;* Alabama, *Peters,* *Beaumont, Earle*; Cuba, *Earle, Underwood & Earle 758, 793, 1104a, 1316, 1319, 1446.*

Microporellus holotephrus (B. & C.)

Polyporus holotephrus B. & C. Jour. Linn. Soc. Bot. **10**: 315. 1868.

Described as follows from *no. 352* of Wright's Cuban collections, although Guiana (*Leprieur 929*) is mentioned as the habitat.

"Luridus; pileo tenui coriaceo flabelliformi, e basi attenuata lineato, hic illic vinoso-tincto zonato, zonis alternis subtiliter velutinis scabris brunneis; poris 5–6-gonis brevibus minimis.

"On dead wood. Pileus 2½ inches broad, 2 inches long, radiato-lineate; pores $\frac{1}{200}$ inch in diameter. A very curious species."

This peculiar plant, known only from the original collections, now at Kew, bears a very close resemblance to *M. dealbatus* in every respect except color. One could almost believe that a few very young plants of *M. dealbatus* had for some cause turned entirely black in drying, if the numerous other collections of this species indicated the slightest tendency in that direction. Another difference is the size of pores, those of *M. holotephrus* being entirely inconspicuous to the unaided eye.

22. POLYPORUS (Mich.) Paul. Icon. Champ. *pl. 13.* 1793.
Type: *Polyporus Ulmi* Paul.

Polyporus (Mich.) Adans. Fam. **2**: 10. 1763. Not associable with a previously published binomial.

Polyporellus Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 37. 1879. Type: *Polyporus brumalis* Fr.

Leucoporus Quél. Ench. Fung. 165. 1886. Type: *Leucoporus tubarius* Quél.

Cerioporus Quél. Ench. Fung. 167. 1886. Type: *Boletus squamosus* Huds.

Melanopus Pat. Hymén. Europ. 137. 1887. Type: *Melanopus squamosus* (Huds.) Pat.

Hymenophore annual, epixylous, small and simple, very rarely large and compound; stipe central, excentric or lateral, much reduced at times in a few species, often partly or wholly brown or black; surface usually smooth, the margin at times ciliate; context white or yellowish, fibrous, tough to corky; hymenium porose, rarely alveolate; spores smooth, hyaline.

Species: *P. hydniceps* B. & C., *P. scabriceps* B. & C., *P. virgatus* B. & C., *P. delicatus* B. & C., *P. dibaphus* B. & C., *P. polyporus* (Retz) Murr., *P. Tuba* B. & C., *P. craterellus* B. & C., *P. Acicula* B. & C., *P. discoideus* B. & C., *P. phaeoxanthus* B. & Mont., *P. columbiensis* Berk., *P. obolus* Ell. & Macbr., *P. aemulans* B. & C., *P. arculariellus* Murr., *P. arcularius* (Batsch) Fr., *P. variiporus* Murr., *P. Tricholoma* Mont., *P. Cowellii* Murr., *P. caudicinus* (Scop.) Murr., *P. maculosus* Murr., *P. elegans* (Bull.) Fr., *P. fissus* Berk., *P. arculariformis* Murr. [See Bull. Torrey Club **31**: 29–44, 1904; and Torreya **4**: 150, 151. 1904.]

Synopsis of the Polyporeae with bright-colored context

Hymenophore sessile or subsessile.
  Pores yellow.
    Context thick and fleshy, plants very large. 1. *Laetiporus.*
    Context thin; plants small. 2. *Flaviporellus.*
  Pores red.
    Context very soft and spongy, tubes large and irregular. 3. *Aurantiporellus.*
    Context firm, tubes small.
      Surface anoderm, tubes fragile.
        Tubes orange-colored, becoming dark and resinous on drying. 4. *Aurantiporus.*
        Tubes remaining orange-colored, or fading slightly. 5. *Pycnoporellus.*
      Surface pelliculose, tubes firm and regular. 6. *Pycnoporus.*
Hymenophore distinctly stipitate; context yellow. 7. *Phaeolopsis.*

1. LAETIPORUS Murr. Bull. Torrey Club **31**: 607. 1904

Type: *Agaricus speciosus* Batarr.

Hymenophore annual, epixylous, fleshy, anoderm, cespitose-multiplex; context cheesy to fragile, light-colored, tubes thin-walled, fragile, bright-yellow, mouths irregularly polygonal; spores smooth, hyaline.

Species: *L. speciosus* (Batarr.) Murr. [See Bull Torrey Club **31**: 607, 608. 1904.]

2. **Flaviporellus** gen. nov.

Type: *Polyporus Splitgerberi* Mont.

Hymenophore small, annual, epixylous, sessile or substipitate, flabelliform, yellow throughout; surface anoderm, margin thin; context very thin and friable; tubes small, thin-walled, fragile; spores smooth, hyaline or yellowish.

Flaviporellus Splitgerberi (Mont.)

Polyporus Splitgerberi Mont. Ann. Sci. Nat. Bot. II. **16**: 109. 1841. Syll. Crypt. 164. 1856.

Polyporus sulphuratus Fr. Nov. Symb. 79. 1851.

Polyporus rheicolor B. & C. Jour. Linn. Soc. Bot. **10**: 313. 1868.

This plant was described from Surinam, Mexico and Cuba successively. It is apparently rare, being known chiefly from type collections at Kew, Paris and Upsala.

3. **Aurantiporellus** gen. nov.

Type: *Polyporus alboluteus* Ell. & Ev.

Hymenophore large, annual, epixylous, effused, immarginate or narrowly reflexed; surface azonate, soft, anoderm and orange-colored when young, becoming slightly encrusted and darker with age; context orange-colored, extremely soft and spongy throughout; tubes orange-colored, very large, thin-walled, irregular, lacerate, fragile; spores smooth, hyaline.

Aurantiporellus alboluteus (Ell. & Ev.)

Fomes alboluteus Ell. & Ev. Proc. Acad. Sci. Phila. **1895**: 413. 1895.

Described from material collected by Crandall on decayed trunks of *Abies subalpina* in Colorado as follows:

"Effused and laterally connate for several centimeters, about 1 cm. thick and 5–6 cm. broad, immarginate and entirely resupinate or, in some specc. with a very slight, reflexed margin of soft, spongy texture and light orange color within and without. Pores large, 1–2 mm. diam., with a thin, membranaceous, white, toothed margin."

In 1898 (Bull. Torrey Club **25**: 513), the authors add the following notes:

"Additional specimens and notes of this species show that it is a *Polyporus* and not a *Fomes*. In the fresh growing state it is very juicy and absorbs moisture to a remarkable degree so that water may be squeezed out of it as from a sponge. Some specimens were 3–4 cm. thick. When mature the pores are prolonged on one side so as to resemble the teeth of an *Irpex*. The spores are oblong, hyaline, 8–12 × 3 μ. Allied to *Polyporus leucospongia* Cke. & Hark."

This species has apparently been found by only two botanists. The type plants were collected July 10, 1894, by C. S. Crandall, *no. 50*, upon charred trunks of *Abies* on the crest of the continental divide, Colorado, at an altitude of 3,000 meters. Specimens were later collected by Bethel, *no. 280*, at Climax, Colorado, at a height of 3,390 meters, on the ends of decaying coniferous logs projecting from the snow.

4. **Aurantiporus** gen. nov.

Type: *Polyporus Pilotae* Schw.

Hymenophore large, annual, epixylous, sessile, dimidiate; surface anoderm, sodden, bibulous, reddish-orange, soon fading; context reddish-yellow, fleshy-tough to woody, juicy when fresh, rigid when dry, conspicuously zonate; tubes small, slender, thin-walled, brilliant orange when fresh, becoming dark, resinous and fragile on drying; spores smooth, hyaline.

Aurantiporus Pilotae (Schw.)

Polyporus Pilotae Schw. Trans. Am. Phil. Soc. **4**: 156. 1834.

Polyporus Pini-canadensis Schw. Trans. Am. Phil. Soc. **4**: 157. 1834.

Polyporus hypococcinus Berk. Lond. Jour. Bot. 6: 319. 1847.

This brilliantly colored species was first described from specimens collected on Pilot mountain, North Carolina, growing on a chestnut log. According to Morgan these specimens had lost their brilliancy when Schweinitz found them, which partly accounts for Berkeley's redescription of the species under the name of *P. hypococcinus* when Lea's younger plants were sent him from Ohio. Original specimens examined at Kew and at Philadelphia are excellently preserved and show the two species to be synonymous. No specimens are to be found, however, of *P. Pini-canadensis*, which Berkeley & Curtis in their commentary on Schweinitz's Synopsis say is certainly the same as *P. hypococcinus*. This species was described from plants found in a pine swamp near Mauch Chunk, Pennsylvania, growing on a trunk of *Pinus canadensis*, according to Schweinitz. It is possible that he was mistaken in the host. Specimens collected by Nuttall on dead deciduous logs in West Virginia are also resupinate and agree well with the description of *P. Pini-canadensis*. *P. Pilotae* and *P. hypococcinus* are only known to occur on very much decayed wood of oak and chestnut.

This species is quite rare, but those who have found it have made good notes on its appearance when fresh; attracted, no doubt, by its striking appearance. As I have observed it growing on old logs at Blacksburg, Virginia, the sporophores are ochraceous to reddish-orange at first, the pileus becoming paler and the hymenium darker with age. The substance within is honey-yellow, changing to reddish, and very zonate. On account of the rather fleshy and sodden character of the sporophore there is considerable shrinkage and change of form on drying. Specimens have been examined from Canada, *Dearness*; Iowa, *Macbride*; Delaware, *Commons* (?); Pennsylvania, *Sumstine*, *Murrill*; West Virginia, *Nuttall*; Virginia, *Murrill*; Ohio, *Morgan*.

SPECIES INQUIRENDAE

POLYPORUS FIMBRIPORUS Schw. Trans. Am. Phil. Soc. 4: 155. 1834. Collected on small fallen chestnut limbs at Bethlehem, Pennsylvania, and described as follows:

"P. subtriangularis, substantia carnosa, aquose spongiosa, omnino *P. mollis*. Pileo glabro, pallido, siccitate ruguloso et contracto volumine. Poris albescentibus, rotundis, minutis, circum apices mire fimbriato ciliatis. Diametro unciali. Tempore sicco indurescit."

The above description agrees in many ways with young stages of *A. Pilotae*, but this latter species has never been collected on small limbs, its usual hosts being much-decayed chestnut or oak logs. The remains of the type specimens at Philadelphia also show a close relationship to *A. Pilotae*.

POLYPORUS CASTANOPHILUS Atk. Jour. Myc. 8: 118. 1902. Collected by Atkinson at Blowing Rock, North Carolina, September 1901 (*no. 10072* Cornell Univ. Herb.), and thus described:

"Pileus dimidiate, sessile, convex, 10–20 cm. broad, 10–12 cm. long, zonate, more or less rugose and sometimes tomentose toward the base, reddish yellow to reddish orange, flesh yellowish, zoned, soft and watery but tough and drying somewhat shrunken but hard and firm. Tubes plane, medium size, dissepiments thin, edges very finely fimbriate, chrome yellow to bright orange, drying dull yellow or reddish brown, tubes 6–8 mm. long. Basidia clavate, 15–20 × 4–5 μ, 4-spored. Spores white, hyaline, smooth, with a few granules, 3 × 2 μ. On decorticated and one-half rotted chestnut logs."

Although I have not been able to examine the plants described above, there seems to be little doubt that they are referable to *A. Pilotae.*

5. **Pycnoporellus** gen. nov.

Type: *Polyporus fibrillosus* Karst.

Hymenophore annual, epixylous, sessile, dimidiate, simple or imbricate, reddish or orange-colored throughout; surface anoderm, margin thin; context thin, friable; tubes thin-walled, fragile, at length lacerate; spores smooth, hyaline or pale yellowish.

Pycnoporellus fibrillosus (Karst.).

Polyporus fibrillosus Karst. Sydv. Finl. Polyp. 30. 1859.

Polyporus aurantiacus Peck, Rep. N. Y. State Mus. Nat. Hist. **26**: 69. 1874.

Inonotus fibrillosus Karst. Bidr. Finl. Nat. och Folk **37**: 72. 1882.

In 1876 Karsten considered this species synonymous with *Polyporus vulpinus* Fr., but later said the two were very different. According to Bresadola, *Ochroporus lithuanicus* Blonski (Hedwigia 281. 1889) is a true synonym of *P. fibrillosus.*

This species is rarely found in Asia, Europe and northern North America on decaying logs of fir, spruce and other conifers. Its bright colors make its discovery easy, while the fragile tubes and rigid, friable context distinguish it readily from *Pycnoporus cinnabarinus.*

Finland, *Karsten;* Canada, *Macoun;* New York, *Peck;* Vermont, *Burt;* Colorado, *Bethel;* Oregon, *Carpenter.*

6. PYCNOPORUS Karst. Rev. Myc. **3**^{9}: 18. 1881

Type: *Boletus cinnabarinus* Jacq.

Hymenophore annual, sometimes reviving, epixylous, sessile, dimidiate, simple or imbricate, rarely pseudo-stipitate; surface anoderm, slightly pelliculose at times, zonate or azonate, bright or dull red; context red, soft-corky to punky; hymenium concolorous, tubes small, firm, thin-walled; spores smooth, hyaline.

Species: *P. cinnabarinus* (Jacq.) Karst., *P. sanguineus* (L.) Murr. [See Bull. Torrey Club **31**: 420, 421. 1904.]

7. **Phaeolopsis** gen. nov.

Type: *Polyporus Verae-crucis* Berk.

Hymenophore annual, expixylous, stipitate; surface azonate, anoderm, yellow or brown; margin acute; context yellow, fleshy to tough and fibrous, not friable; tubes yellow, regular, minute, thin-walled; spores smooth, hyaline: stipe excentric or lateral with substance and surface like that of the pileus.

Phaeolopsis Verae-crucis (Berk.)

Polyporus Verae-crucis Berk. Ann. Mag. Nat. Hist. **10**: Suppl. 369. *pl. 9–12.* 1843.

Described from plants collected on the roots of trees at Vera Cruz, August, 1854. Type plants at Kew are in an excellent state of preservation. The context of these herbarium specimens is dark yellowish-orange and the stipe excentric or lateral.

SUBFAMILY 2. FOMITEAE

Synopsis of the Fomiteae with white or flesh-colored context

Tubes at first concealed by a volva. 1. *Cryptoporus.*
Tubes free from the first.
  Surface of hymenophore covered with reddish-brown varnish; context corky. 2. *Ganoderma.*
  Surface of hymenophore not as above, or, if so, context woody. 3. *Fomes.*

1. CRYPTOPORUS Shear, Bull. Torrey Club **29**: 450. 1902

Type: *Polyporus volvatus* Peck.

Hymenophore subglobose, sessile, epixylous; surface smooth, encrusted; context white, corky; tubes white, concealed at first by a volva, which breaks at one or more points at maturity; mouths constricted, discolored; spores smooth, hyaline.

Species: *C. volvatus* (Peck) Shear. [See Bull. Torrey Club **30**: 423, 424. 1903.]

2. GANODERMA Karst. Rev. Myc. 3^9: 17. 1881

Type: *Boletus lucidus* Leyss.

Placodes Quél. Ench. Fung. 170. 1886. Type: *Boletus lucidus* Leyss.

G. Tsugae Murr. and a few other species of this genus might be classed with white-fleshed forms, especially in their early stages. [See Bull. Torrey Club **29**: 599–608. 1902].

3. FOMES Gill. Champ. Fr. **1**: 682. 1878

Type: *Polyporus marginatus* Fr.

Fomitopsis Karst. Rev. Myc. 3^9: 18. 1881 Type: *Boletus pinicola* Sw.

Heterobasidion Bref. Unters. 8 : 154. 1889. (Not *Heterobasidium* Mass. 1888.) Type: *Polyporus annosus* Fr.

Hymenophore sessile, ungulate or applanate, epixylous; surface anoderm or encrusted, sulcate, rarely zonate; context white or flesh-colored, woody, rarely punky; tubes cylindrical, concolorous, usually thick-walled, stratose; pores smooth, hyaline.

Species: *F. roseus* (Alb. & Schw.) Cooke, *F. annosus* (Fr.) Cooke, *F. ungulatus* (Schaeff.) Sacc., *F. Ellisianus* Anders., *F. fraxinophilus* (Peck) Sacc., *F. ligneus* (Berk.) Cooke, *F. stipitatus* Murr., *F. perpusillus* (Pers.) Cooke, *F. scutellatus* (Schw.) Cooke, *F. Laricis* (Jacq.) Murr., *F. populinus* (Schum.) Cooke, *F. Meliae* (Underw.) Murr., *F. rubritinctus* Murr., *F. geotropus* Cooke. [See Bull. Torrey Club **30**: 225–232. 1903.]

An original specimen of Persoon's *Polyporus perpusillus*, published by Léveillé in 1844, shows this plant to be the same as *Trametes ohiensis* Berk., published in 1872. Persoon's name, therefore, must be adopted instead of the one under which the species is commonly known. Considering the very small size of the species, the older name seems exceedingly appropriate.

To the above list of species should be added **Fomes Auberianus** (*Polyporus Auberianus* Mont. Pl. Cell. Cuba 397. 1842), described from Cuban plants collected by Auber. It is a large and striking species found on wounded trunks or dead logs of hardwood trees throughout tropical America. Material is at hand from Cuba, *Earle*, *Earle & Wilson 253*, *Earle & Murrill 4*; Porto Rico, *Wilson 32*; St. Kitts, *Britton & Cowell 328*; Martinique, *Duss*; Mexico, *Smith*.

SUBFAMILY 3. AGARICEAE

Synopsis of the Agariceae with white context

Surface glabrous, hymenium usually labyrinthiform.	1. *Agaricus*.
Surface pubescent or hirsute.	
Hymenium at first labyrinthiform, soon becoming irpiciform.	2. *Cerrena*.
Hymenium lamellate, not becoming irpiciform.	3. *Lenzites*.

1. AGARICUS (Dill.) L. Sp. Pl. 1176. 1753

Type: *Agaricus quercinus* L.

Striglia Adans. Fam. **2**: 10. 1763. Type: *Agaricus quercinus* L.

Daedalea Pers. Syn. Fung. 499. 1801. Type: *Agaricus quercinus* L.

Daedaleopsis Schroet. Krypt. Fl. Schles. **3**: 492. 1888. Type: *Boletus confragosus* Bolt.

Hymenophore epixylous, usually large and annual, sessile, applanate to ungulate; surface anoderm, glabrous, often zonate: context white or wood-colored, rigid, woody or punky: hymenium normally labyrinthiform, but varying to lamellate and porose in some species: spores smooth, hyaline.

Species: *A. quercinus* L., *A. juniperinus* Murr., *A. confragosus* (Bolt.) Murr., *A. Aesculi* (Schw.) Murr., *A. deplanatus* (Fr.) Murr. [See Bull. Torrey Club **32**: 83–95. 1905.]

2. CERRENA S. F. Gray Nat. Arr. Brit. Pl. **1**: 649. 1821

Type: *Boletus unicolor* (Bull.) Bolt.

Phyllodontia Karst. Hedwigia **22**: 163. 1883. Type: *Phyllodontia Magnusii* Karst.

Hymenophore small, epixylous, sessile, conchate, annual; surface anoderm, hairy, zonate or sulcate; context thin, white, fibrous, flexible; hymenium at first labyrinthiform, soon becoming irpiciform from the splitting of the dessepiments; spores smooth, hyaline.

Species: *C. unicolor* (Bull.) Murr. [See Bull. Torrey Club **32**: 97–99. 1905.]

3. LENZITES Fr. Gen. Hymen. 10. 1836

Type: *Daedalea betulina* (L.) Fr.

Hymenophore small, annual, epixylous, sessile, conchate: surface anoderm, usually zonate and tomentose; context white, coriaceous, flexible; hymenium lamellate, the radiating gill-like dissepiments connected transversely at times, especially in youth; spores smooth, hyaline.

Species: *L. betulina* (L.) Fr., *L. cubensis* B. & C. [See Bull. Torrey Club **32**: 95–97. 1905.]

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STUDIES ON THE FLORA OF SOUTHERN CALIFORNIA

By LE ROY ABRAMS

NEW YORK
1905

[From the BULLETIN OF THE TORREY BOTANICAL CLUB 32: 537-541. 1905]

[From the Bulletin of the Torrey Botanical Club, 32 : 537–541. 1905.]

Studies on the flora of Southern California

LeRoy Abrams

Hookera multipedunculata sp. nov.

Bulbs 2–2.5 cm. broad : scapes several, ascending, 8–15 cm. long, the upper three fourths being exposed above the ground, 1 mm. in diameter : leaves equaling or exceeding the scapes, 5 mm. broad, conduplicate : umbels 5–13-flowered : bracts several, 5 mm. long : pedicels 2–3 cm. long : perianth funnelform, 15 mm. long, rose-purple, its segments 9–10 mm. long, the outer lanceolate, the inner slightly broader : staminodia wanting ; stamens 3 ; filaments 3 mm. long ; anthers 5 mm. long : style 6 mm. long : mature capsule oblong-obovate, 5 mm. long.

Closely related to *H. filifolia* (S. Wats.) Greene, but distinguished by the absence of staminodia and by the stalked rather than sessile anthers ; the bracts are also much less conspicuous.

Growing in heavy soil near Cuyamaca Lake, San Diego County, *Abrams 3897*, June 25, 1903. The type of this, as well as those of the following new species, is in the Herbarium of the New York Botanical Garden.

Abronia pinetorum sp. nov.

Apparently perennial, from a rather thick, fleshy tap-root ; stems branching from the base, ascending or prostrate ; herbage glandular-villous throughout : petioles slender, 1–3 cm. long ; blades thickish, mostly ovate, obtuse or rounded at apex, cordate or rounded at base, 1–2 cm. long : peduncles 3–6 cm. long : involucral bracts ovate-lanceolate, 5–7 mm. long, acuminate : perianth bright rose-purple ; tube slender, 2 cm. long ; lobes 5–7 mm. long, rather deeply lobed : wings of fruit rounded at apex and but little prolonged above, forming a broad shallow sinus.

Open pine forests, Thomas Valley, San Jacinto Mountains, *Hall 2166*, June, 1901.

Abronia aurita sp. nov.

Herbage glandular-villous ; stems prostrate or nearly so : petioles 1–3 cm long ; blades rather thin, ovate, 15–40 mm. long, oblique at base, margins wavy-crenate : peduncles 4–7 cm. long : bracts narrowly lanceolate, long-acuminate, 1 cm. long : flowers mostly about 20 : perianth rose-colored ; tube 2 cm. long ; lobes

5–6 mm. long, rather deeply lobed: wings of fruit obtuse at apex, much prolonged above forming a deep rather narrow sinus.

The narrow bracts and peculiar wings, which resemble the ears of a coyote, distinguish this best from the preceding species; while the larger flowers readily distinguish both from *A. villosa* S. Wats., with which they have been confused.

Palm Springs, *S. B. Parish 4138*, April, 1896 (type); open sandy plain, Riverside County, *Grant 4444*, 1901; vicinity of Winchester, *Hall 2915*, no date.

Delphinium Cuyamacae sp. nov.

Root rather stout, fasciculately branched 3–5 cm. below the surface, the branches not at all fusiform: stem erect, simple or in large specimens with one or two short slender flowering branches from near the base of the raceme, rather stout and somewhat fistulous below, 4–6 dm. high, pale-green and cinereous with a fine close puberulence: basal leaves on very stout cinereous-puberulent petioles 6–9 cm. long, dissected into rather broadly linear lobes, 2.5–3 cm. broad, densely puberulent beneath, less so above; stem-leaves on closely erect stoutish petioles, similar to the basal but becoming smaller and more dissected: raceme simple, narrow, rather dense above, the lower scattered flowers on pedicels about 2 cm. long, the upper ones on pedicels about 1 cm. long: sepals purple, puberulent without, the lower oval, 8 mm. long, the lateral broadest above the middle, acutish, slightly exceeding the lower; spur straight or nearly so, 3–4 mm. longer than the blade and about 2 mm. broad at the upper end, gradually tapering: lower petals rose-purple, their claws slender, 6 mm. long, the blades rounded in outline, 5 mm. broad, usually cleft to the middle, ciliate on the margin and with a tuft of whitish hairs on the back; upper petals purple except the lower whitish margin, 7 mm. long, 3 mm. broad at the oblique apex: ovary and immature capsules nearly glabrous: mature fruit not seen.

Apparently closely related to *D. Hanseni* Greene, from which it is best distinguished by the character of its pubescence and purple flowers.

On grassy slopes bordering Cuyamaca Lake, altitude 1550 meters, San Diego County, *Abrams 3888*, June 26, 1902.

Acrolasia Davidsoniana sp. nov.

Stems slender, erect, simple below, 3–4 dm. high: leaves linear or linear-lanceolate, 1–3 cm. long, entire: flowers in clusters of 2–4, terminating the rather few ascending branches: bracts oblanceolate or spatulate, entire above or shallowly toothed, scarious below, viscid-pubescent, ciliate on the margins: hypanthium 8–10 mm. long: sepals triangular-lanceolate, 1 mm. long: petals obovate, 2 mm. long.

Much less branched than *A. congesta* (Nutt.) Rydb.; flower-clusters not so large; bracts and calyx-lobes only half the size.

Summit of Mt. Wilson, *Abrams 2580*, June 30, 1902 (type); along cañons at 1800–2000 meters altitude, San Antonio Mountains, *Hall 1228*, June 18, 1899, in part. Reported from Mt. Wilson by A. Davidson (Bull. So. Calif. Acad. **4**: 40. 1905), under the name *Mentzelia congesta.*

Sphaerostigma pallidum sp. nov.

Annual; stems branching from the base, slender, 1–2 dm. long, sparsely puberulent: leaves canescent with a fine appressed pubescence, the basal ones narrowly oblanceolate, tapering to a long petiole, 4–6 cm. long, 3–4 mm. broad, those of the stem linear-lanceolate, 2–3 cm. long: flowers scattered along the stems from the very base: calyx-lobes silky, 3 mm. long: petals pale-yellow, about 5 mm. long, turning reddish with age: stamens and style about half the length of the petals: capsule slender, attenuate at apex into a short beak, more or less contorted, 2–2.5 cm. long, 1 mm. broad.

This species is of the *S. bistortum* group, but is readily distinguished by its fine appressed pubescence, being not at all hirsute.

Apparently confined to the desert slopes, the following specimens being before me: Palm Springs, *Parish*, April, 1896; Coyote Cañon, *Hall 2791*, April, 1902; Cabazon, *Abrams 3228*, April 6, 1903 (type).

Godetia delicata sp. nov.

Stem erect, slender, simple or branching, 3–6 dm. high: leaves linear, slightly sinuate-toothed, puberulent on the margins, otherwise glabrous, 2–4 cm. long, 3–6 mm. wide: flowers scattered; buds nodding, somewhat obovate when well developed, 8–10 mm. long, these and the sessile hypanthium minutely puberulent: calyx-lobes adherent, turning to one side, not reflexed: petals pink, 15 mm. long, 8 mm. wide at the abruptly rounded apex, tapering to the base, becoming narrow and claw-like below: stamens opposite the petals 9 mm. long, their anthers whitish, 4 mm. long, those alternate with the petals 12 mm. long, their anthers bright-red, 6 mm. long: style slender, 10 mm. long; stigmalobes broadly obovate, 1.5 mm. long: capsule sessile, linear, quadrate, 2 cm. long, 2 mm. broad, slightly sulcate between the angles at the insertion of the placentae when dry, not at all costate, tapering at the apex into a beak 2–3 mm. long.

This species is nearest *G. epilobioides* (Nutt.) S. Wats., but that has pedicellate capsules, smaller cream-colored obovate petals, and smaller yellowish anthers.

Frequent on shady slopes between Potrero and Campo, San Diego County, *Abrams 3710*, June 3, 1903.

Gilia caruifolia sp. nov.

Annual; stem erect, 3–6 dm. high, paniculate-branched above, the ultimate branches numerous, almost capillary, beset with tack-shaped glands, stem otherwise glabrous: basal leaves pinnate, the pinnae pinnatifid; lobes entire or toothed, apiculate, sparsely viscid-pubescent; lower stem-leaves similar but more reduced, upper becoming small entire lanceolate bracts: pedicels 5–10 mm. long, capillary: flowers solitary: calyx 2 mm. long, white-scarious except the midrib, the teeth scarcely equaling the tube, triangular, very acute: corolla pink; tube slender, 2.5–3 mm. long, slightly exceeding the calyx; limb funnelform; lobes ovate, 2.5 mm. long: filaments inserted about 1 mm. below the sinuses, equaling the corolla-lobes; anthers 0.5 mm. long: style 12 mm. long: capsule oblong, 3–5 mm. long, the seeds about 7 to each cell.

Distinguished from *G. tenuiflora altissima* Parish, with which it has been confused, by its more diffusely branching inflorescence, and short-tubed corolla.

Cuyamaca Mountains, between Cuyamaca Lake and Oriflamme Cañon, *Abrams 3940*, June 28, 1903 (type); Palomar Mountain, altitude 1600 meters, *Chandler 5371*, July 6, 1904.

Diplacus aridus sp. nov.

Low glutinous shrub, 2–4 dm. high, the leaf-bearing branches stramineous, beset with small sessile resinous glands, otherwise glabrous, densely leafy: leaves pale yellowish-green, lanceolate, tapering to a short winged petiole, 2.5–4 cm. long, 7–15 mm. broad, glabrous except for the sessile glands on lower surface, the margins revolute, remotely and obscurely toothed: flowers on pedicels 6 mm. long: calyx 3 cm. long, strongly inflated above, rather abruptly narrowing to a tube 12 mm. long, its teeth unequal, the larger 8 mm. long: corolla pale buff-colored, 4.5–5 cm. long, the long slender tube exceeding the calyx; lobes thickish, those of the upper lip 5 mm. long, 7 mm. broad, shallowly toothed, those of the lower lip 4 mm. long, 5 mm. broad, slightly lobed or entire.

The peculiar calyx and long slender corolla-tube, as well as the pattern of the lobes, readily distinguish this species from all the other members of the genus.

Growing on dry rocky ridges at Jacumba, near the boundary monument, *Abrams 3656*, May 31, 1903.

WYETHIA OVATA T. & G. Emory's Rep. 143. 1848

W. coriacea A. Gray, Proc. Am. Acad. **11**: 77. 1878.

Not *W. ovata* A. Gray, Proc. Am. Acad. **7**: 357. 1868.

Emory's material, according to the label on the type in the Herbarium of Columbia University, was collected on "Dec. 4, 1846." Turning to Emory's notes on page 107 of the work cited above, we find that the expedition of which he was a member left Warner's Ranch on the morning of this date, and pitched camp, "after marching 13½ miles, in the valley of Rio Isabel, near the rancheria of Mr. Stokes, formerly the mission of Saint Isabel." *W. coriacea* was based on specimens collected by Dr. Palmer "on the Mesa Grande, 70 miles north-east of San Diego." As the Mesa Grande lies between Warner's Ranch and San Isabel, and is traversed by the old Fort Yuma and San Diego road, it is clearly evident that the two series of specimens were collected in the same region. And a comparison of the specimens proves them to be identical.

The taking up of this name by Dr. Gray in the Synoptical Flora for his own *W. ovata* of northern California was unquestionably ill-advised.

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PHYCOLOGICAL STUDIES—II.
NEW CHLOROPHYCEAE, NEW RHODOPHYCEAE AND MISCELLANEOUS NOTES

By MARSHALL AVERY HOWE

NEW YORK
1905

[From the BULLETIN OF THE TORREY BOTANICAL CLUB **32**: 563-586. 1905]

[From the Bulletin of the Torrey Botanical Club, 32: 563-586, *pl. 23-29*. 1905]

Phycological studies — II. New Chlorophyceae, new Rhodophyceae, and miscellaneous notes *

Marshall Avery Howe

(With plates 23–29)

A. NEW CHLOROPHYCEAE

Halimeda favulosa sp. nov.

Of a light bright-green when living, often albescent or yellowish on drying, rather flaccid, suberect or more commonly decumbent (especially if uncovered at low tide), somewhat easily friable when dry, the surface then strongly favulose even to the naked eye and with a subcrystalline lustre ; plants reaching a height or length of 9–22 cm., usually of congested habit, the numerous branches mostly originating near the very short, flattened stipe, this consisting of 1–4 more or less fused segments : rhizoids forming a bulbous mass with the adherent granules of sand : segments variable in form, ranging, without apparent order, from discoid and often trilobed to cylindrical and entire in different parts of a single individual, 4–9 mm. long, 2–9 mm. broad, 0.5–2 mm. thick : peripheral utricles turbinate, subcrateriform, obovoid, or pestle-shaped, 150–400 μ long, 110–260 μ in diameter in surface view, supported and separated by calcareous calyces, the exposed rounded-obtuse or truncate apical portion strongly collapsed on drying, even the whole utricle often withdrawing from the calcareous lateral walls and shriveling to the bottom of the cup ; utricles free on decalcification or but slightly and irregularly coherent ; subcortical layer thin, the central filaments easily visible through the cortex after removal of the lime : filaments of the central strand coherent at the nodes, being there closely connected by

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* Investigation aided by a grant from the John Strong Newberry Fund of the Council of the Scientific Alliance of New York.

very short anastomosing processes. [PLATE 23, FIGURE 2; PLATE 24; PLATE 26, FIGURES 1–6.]

Near low-water mark in the Bahama Islands: *no. 3981*, type (Cave Cays, Exuma Chain, 19 February 1905, M. A. H.); *nos. 3417b* and *3421b* (Rose Island); *no. 4186a* (Stocking Island, Exuma Harbor).

Halimeda favulosa simulates in form, size and habit certain conditions of *H. tridens* (Ell. & Soland.) Lamour. or of *H. tridens Monile* (Ell. & Soland.) * but is easily and constantly distinguished by the very large peripheral utricles (110–260 μ *vs.* 33–68 μ in *H. tridens*) which, on drying, collapse or withdraw into the subtending and separating lime-cups, leaving the surface conspicuously and rather beautifully favulose. In the character of the peripheral utricles the species suggests *H. macrophysa* Ask., though its utricles are sometimes even larger than in that, according to the measurements given by Askenasy and by Barton, but it has the size, form, and node-characters of the *H. tridens* group instead of the *H. Tuna-H. macrophysa* alliance. It evidently bears a relation to *H. tridens* similar to that of *H. macrophysa* to *H. Tuna*. In case of three out of the four collection numbers cited above, *H. favulosa* was found growing in company with *H. tridens* or *H. tridens Monile* and resembling them so much in habit that the distinctive characters escaped observation at the time of gathering.

There is a possibility that *Halimeda favulosa* will prove to be *H. brevicaulis* Kütz., † described from the Bahamas, but the doubts in regard to this can probably never be resolved unless Kützing's specimen, which now seems to be lost, is found.‡ *H. brevicaulis*, according to Kützing's figure and brief description, might equally well be a form of the extremely variable *H. tridens*, which is more abundant in the same region. The short stipe of "*brevicaulis*" has no special significance, but the apparently flaccid habit and tapering branches, it must be admitted, are rather suggestive of *H. favulosa*. Yet flaccid, decumbent conditions of *H. tridens* occur. Kützing describes the stipe of *H. brevicaulis* as terete, while in all the specimens of *H. favulosa* that we have seen it is much flattened and in all the branching is much more congested. Furthermore, it seems hardly probable that Kützing, doubtless studying a dried specimen, would have failed to notice the peculiar and striking favulosity of the surface if he had had before him the species described above. Kützing's figure of *Halimeda Monile* (*l. c. pl. 26. f. 1*) illustrates the habit of the moniliform condition of *H. favulosa* rather well.

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* **Halimeda tridens Monile** (Ell. & Soland.)
Corallina Monile Ell. & Soland. Nat. Hist. Zooph. 110. *pl. 20. f. c.* 1786.

† Tab. Phyc. 8: 11. *pl. 25. f. 2.* 1858.

‡ See "Addendum" on page 586.

Hauck (Hedwigia **25**: 168. 1886) has gone on record as having seen an authentic specimen of *H. brevicaulis*,* but neither in the herbarium of Hauck nor that of Kützing, both now owned by Mme. Weber-van Bosse, is such a specimen to be found. The species is unrepresented also in a set of cotypes sent by Kützing to Montagne and now preserved in the Muséum d'Histoire Naturelle at Paris.

The Ellis and Solander types of *Halimeda* are said also to have disappeared † but none of their figures and descriptions of West Indian forms is especially suggestive of *H. favulosa*; at least, such an application is not likely to be proved in absence of original specimens.

In *Halimeda favulosa*, the peripheral utricles and sometimes the filaments of the subcortical layer and of the central strand are now and then gorged with dense granular contents as shown in our FIGURE 4. We have found no evidence that such parts become detached, but for some reason a reserve food supply seems to be concentrated in them.

Avrainvillea levis sp. nov.

Olivaceous when living, on drying often slightly tinged with yellow or verging toward cinereous, or at the margins sometimes fuscous, caespitose or gregarious from a short, scarcely rhizomatous base: stipe 0.5–4 cm. long, flattened or subcylindrical, simple or occasionally dichotomous at base: flabellum varying from reniform-suborbicular with cordate base to cuneiform-obovate, 1–7 cm. broad, entire, erose, or sometimes lobed, thin and membranous or sometimes thicker and coriaceous, compact in texture with a smooth or slightly wrinkled surface, for the most part distinctly zonate, now and then tending to form serially superposed flabella at the margins of the zones: filaments of flabellum slender, tortuous, interwoven, usually lightly and irregularly torulose, rarely somewhat moniliform, mostly 6–24 μ in diameter; those of interior often a little larger (reaching 35 μ), more chlorophyllose and less tortuous: angle of dichotomy commonly acute (about 30°–45°), sometimes obtuse (reaching 120°). [PLATE 23, FIGURE 1; PLATE 23, FIGURES 8–10.]

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* Printed "*multicaulis*" by Hauck through an evident *lapsus*, as shown by label on Comoro specimen cited.

† Barton, E. S. The Genus *Halimeda*. Siboga-Expeditie, Monographe **60**: 1, 2. 1901.

In the Bahama Islands, near low-water mark, or when growing under a rock overhang sometimes exposed at low tide: *no. 3996*, type (Cave Cays, Exuma Chain, 19 February 1905, M.A.H.); *no. 3574* (Frozen Cay, Berry Islands); *no. 3966* (Shroud's Cay, Exuma Chain).

The above-described species, though here appearing under a new specific name attached to a new nomenclatorial type, is doubtless the same as the species described by Murray and Boodle (Jour. Bot. **27**: 70. 1889) under the designation "*A. sordida* Crn. excl. syn." But according to both the Philadelphia and the Vienna codes of nomenclature, the use of the name *Avrainvillea sordida* for this species cannot be justified unless perchance it can be shown to be identical with the species described from the Philippines by Montagne in 1844 as *Udotea sordida*. The combination "*A. sordida* (Mont.) Crn. mscr." apparently first appeared in print in Mazé and Schramm's Essai de Classification des Algues de la Guadeloupe (p. 89. 1870–'77) and is there based on quoted synonymy, the citation of Guadeloupe specimens under collection numbers, and the following description: "De couleur brune olivâtre à l'état de vie." Under these circumstances, when one excludes synonymy one excludes all that has technical value in publication, and the name *Avrainvillea sordida* Crn., if used at all, must be made to apply to Montagne's plant. Our species, if it is to be kept separate from its Eastern Hemisphere analogue, as at present we believe it should, deserves a distinctive name.

Avrainvillea levis has a smooth compact surface that suggests a *Udotea* at first sight, though its structure is clearly that of an *Avrainvillea*. The filaments of the flabellum, however, are not so uniform in character as is the case in the other West Indian species of the genus, the filaments of the surface being often more slender, more tortuous, and less chlorophyllose than those of the interior.

Avrainvillea levis, so far as our experience goes, is the most constant and most easily recognized of the West Indian forms of this puzzling genus. Our remaining specimens, representing at the present time about thirty localities, can be arranged, though rather unsatisfactorily, in two groups, which for the present we are designating as *Avrainvillea nigricans* Decaisne and *A. Mazei* Murray & Boodle. *Avrainvillea longicaulis*, as described and figured by Murray and Boodle,* we are convinced cannot be considered specifically different from *A. nigricans*, as represented by the probable type of the latter species preserved in the herbarium of the Muséum d'Histoire Naturelle in Paris.

The type of *Avrainvillea nigricans* Decaisne is referred to in the following words in the place of original description: † "In Antillis (îles des Saintes propè la Guadeloupe). — Cl. d'Avrainville. (v. in Herb. Mus. Paris.)." In the herbarium of the Paris museum, there is at the present time no specimen of d'Avrainville's collecting bearing the name *Avrainvillea nigricans*, but there is a single specimen associated with a label inscribed in Decaisne's hand: "*Avrainvillea nigra* Dne. Iles des Saintes près la Guadeloupe. M. D'Avrainville. 1842," and as this agrees with the description published under the specific name *nigricans*, there can be no reasonable doubt that it is the true type of the species in question. This specimen has a single somewhat worn and broken flabellum supported by a stipe a trifle more than 1 cm. long springing from a subcylindrical rhizome 3.5 cm. long, which is continued beyond into what may have been the stipe of another flabellum; the flabellum proper has a length of 3.3 cm. and its original width was probably about the same; the filaments of the flabellum are moniliform, as originally described, and have a diameter of 44–55 μ. We can discover nothing beyond its smaller size to distinguish it from the *A. longicaulis* of Murray and Boodle. The original *Rhipilia longicaulis* of Kützing ‡ "Ad Antillas (Herb. Sonder)" has not been found in the Kützing herbarium now owned by Madame Weber-van Bosse, and an inquiry in regard to it has been addressed to Melbourne, Australia, where the Sonder herbarium, cited by Kützing, is supposed to be.§ The plant needs further study. We have never seen filaments from a flabellum ending in slender hyaline hairs like those figured and described by Kützing.

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[*] Jour. Bot **27**: 70. *pl. 288. f. 1–5.* 1889.

[†] Ann. Sci. Nat. II. **18**: 108. 1842.

[‡] Kütz. Tab. Phyc. **8**: 13. *pl. 28. f. 2.* 1858.

[§] See "Addendum" on page 586.

Rhizoidal filaments often have such a character but Kützing states that the figured filament came "aus dem Phyllom."

Avrainvillea nigricans and *A. Mazei*, as we interpret them, are best distinguished by the character of the filaments of the flabellum, those of *A. nigricans* being moniliform and those of *A. Mazei* being cylindrical with an abrupt constriction at the base of each branch. The flabellum in *A. Mazei* tends to be more diffuse, fluffy, and irregular, and it is often greener. In three cases, we have found the two growing side by side and perfectly distinct in form, color, and in the microscopic characters of the threads, yet elsewhere specimens have sometimes been found which seem to hold a rather doubtful intermediate position. In one case (Bermuda, *no. 109*) filaments from two flabella springing from a single rhizome have different characters, those from the one being clearly of the *Mazei* type while those from the other make a close approach to the regularly moniliform condition of *A. nigricans*. The fact that *A. nigricans* and *A. Mazei* have been found wholly distinct when growing together under apparently the same conditions leads to the opinion that they should be considered separate species in spite of some present difficulties in the way of always recognizing them. Each of the two presents wide variations in form, size and color. What we believe to be a low-littoral or shallow-water condition of *Avrainvillea Mazei* forms greenish-brown, caespitose masses near low-water mark on exposed rocks, and has finger-shaped or round-capitate lobes, not developing a flabellum unless it descends a decimeter or more below the low-tide line. Among the forms that we are at present identifying with *A. nigricans*, one extreme is represented by plants with a suborbicular flabellum (reniform-cordate when young), reaching a width of 25 cm., supported by a cylindrical stipe, which has a maximum length, so far as observed, of 16 cm., this springing from a strongly developed rhizome; the other extreme has a cuneiform flabellum, sometimes no more than 1–2 cm. wide, tapering gradually to a flattened scarcely recognizable stipe, with rhizome poorly developed. Between these two extremes there seems to be a nearly perfect series of intermediates, but perhaps further familiarity with the genus, particularly with living specimens, will result in the recognition of some satisfactory basis for specific distinctions.

Cladocephalus gen. nov.

A genus of *Chlorophyceae* of the family *Codiaceae.* Thallus erect, consisting of capitulum and stipe, the latter attached to the substratum by matted rhizoids, all parts destitute of calcareous incrustation. Stipe and branches of the capitulum corticated, the medullary portion consisting of parallel, sparingly dichotomous chlorophyllose filaments, the cortical layer composed of much narrower, intricate, repeatedly divaricate-dichotomous filaments, which are finally deficient in chlorophyl. Capitulum thamnioid or scopiform, made up of numerous, irregularly dichotomous, non-zonate, often coherent or anastomosing branches. Mode of reproduction unknown.

The genus *Cladocephalus*, though having a slight superficial resemblance to *Penicillus* in habit and form, is most nearly allied to *Avrainvillea*, being in some respects intermediate between that genus and *Udotea.* It differs from both *Avrainvillea* and *Udotea* in having a thamnioid or scopiform capitulum instead of a flabellum; from *Avrainvillea* also in possessing a well-differentiated cortex; from *Udotea* also in the absence of zonation and from its corticated species in the intricate, labyrinthiform character of the cortex, which is made up of more regularly dichotomous, less pectinate filaments. *Cladocephalus* is doubtless as distinct from *Avrainvillea* as *Avrainvillea* is from *Udotea* and more so than *Rhipocephalus* is from *Penicillus.** The genus, so far as known to the writer, is monotypic, the only species being

Cladocephalus scoparius sp. nov.

Very dark green or nigrescent when living, commonly becoming yellowish-brown, substramineous, or olivaceous on drying, solitary or gregarious, 5–14 cm. high; rhizoids forming a somewhat bulbous mass: stipe 2–10 cm. high, 3–7 mm. thick, subcylindrical or somewhat complanate, often alate or canaliculate above, simple or occasionally once or twice dichotomous, the branches sometimes again connate: capitulum scopiform, varying in outline from elongate-fusiform or elongate-ellipsoid to obovoid or subspherical, often somewhat flattened, 3–8 cm. long; branches subcylindrical or complanate, 0.3–2 mm. broad, frequently connate at points of casual contact, now and then subdenticulate near apices: filaments more or less fuscous in the older parts, sometimes bright-green in the younger; filaments of the cortex labyrinthine, lightly torulose when young, the ultimate branches in older parts 6–11 μ in diameter, finally subhyaline; filaments of medulla cylindrical or lightly and irregularly torulose, 30–75 μ in diameter, slightly or not at all constricted just above a dichotomy, covered by cortex at apices or rarely protruding: stipe similar to the capitulum in structure, its cortex a little thicker and firmer. [PLATE 25; PLATE 26, FIGURES 11–20.]

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* *Codiophyllum* J. E. Gray, judging from the author's description and figures (Ann. & Mag. Nat. Hist. IV. 10: 139–141. *pl. 9.* 1872), is very different in structure, if indeed it is really a plant.

Rare and local in the Bahama Islands, on sandy or muddy bottom in 2–10 dm. of water (low tide): *no. 4079*, type (in a tidal pond, Georgetown, Great Exuma, 24 February 1905, M.A.H.); *no. 3081* (south shore of New Providence, 10 April 1904 — a single specimen).

Besides the single specimen collected on the shores of New Providence, we have thus far met with this remarkable plant on only one occasion, when several hundreds were found growing associated with two species of *Penicillus* in a small area in an inland pond which had been connected with the sea by an artificial canal. They seemed here to be in all stages of development, but unfortunately we have been unable to find in them anything that could be taken with confidence to be reproductive bodies. There are often, lying on and among the threads of the cortex, ovoid or subglobose bodies 40–50 μ in diameter, with densely granular contents, much resembling the supposed reproductive bodies figured by Kützing * for his *Rhipozonium lacinulatum* (*Udotea Desfontainii*); but these seem to be always free and unattached, their contents are of a little different green, and we believe that they represent an independent organism.

While the plant is uncalcified in the ordinary sense of the term, the stipe or its base is commonly infiltrated with multitudes of minute crystals which lie free in irregular clusters among the filaments, particularly of the cortex. When a piece of the stipe is dissected in a drop of water they often wash out in such numbers as to give a milky appearance to the water. The crystals dissolve with the evolution of gas on the application of acetic acid and are taken to be calcium carbonate.

The cortex is formed by branches originating subdichotomously from the more peripheral members of the medullary strand and becoming afterwards apparently lateral. These branches then undergo repeated divaricate forkings with a gradual diminution of diameter until finally they may have only one-fifth or even one-twelfth the diameter of the filaments of the central strand.

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* Phyc. Gen. *pl. 42. III. f. 2.* 1843.

B. NEW RHODOPHYCEAE

Sarcomenia filamentosa sp. nov.

Rose-red on drying or sometimes brownish-red, very delicate, gelatinous, gregarious or caespitose-pulvinate on other algae, 4–16 cm. long, pseudodichotomous below; main axes distinctly corticated for one-half to four-fifths the length of the plant, subcylindrical or complanate, ancipitous, 0.25–0.9 mm. in diameter near base, bearing occasional divaricate, rather rigid, simple or dichotomous septate rhizoids on the opposite lateral margins: cells of cortex polymorphous, ranging from orbicular and triangular-ovate to oblong and linear, toward base sometimes 12–16 times as long as broad: main branches dissolving above in numerous narrowly linear or ribbon-shaped articulate uncorticated branchlets 50–170 μ wide, these springing from the mid-ventral * line of the next older branch, their segments ⅔–1½ times as long as broad, consisting of four pericentral siphons and a pair of short cortical (?) siphons arranged end to end on each lateral margin, occasional marginal cells enlarged and more or less protuberant (potentially rhizoids); cross-sections of branchlets about twice as broad as high, showing a distinct costa, this especially prominent ventrally; branchlets furnished toward their apices with a secund mid-ventral row of unbranched monosiphonous filaments, these 0.2–1 mm. long, originating singly from a cell cut off from the anterior end of the ventral siphon of each segment, deciduous in older parts, cells of filament 7–20 in number, mostly 2–6 times as long as broad: reproductive organs unknown. [PLATE 27; PLATE 29, FIGURES 1–11].

On *Sargassum*, corallines, etc., washed ashore. Florida: *no. 2844*, type (Cape Florida, Biscayne Key, 29 March 1904, M.A.H. — also *nos. 2860* and *2865*); *no. 2822* (Virginia Key, 22 March 1904).

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* We use "dorsal" and "ventral" in the sense in which these terms are employed by J. Agardh (Anal. Alg. Cont. 5: 122–149. 1899) in apparent conformity with the customary usage as applied to leaves of cormophytes, the "ventral" being the "inner" or "upper" side. However, a comparison with creeping species of the superficially somewhat similar genus *Herposiphonia* suggests the possibility that these terms, if used at all, should be applied in the reverse sense.

Sarcomenia filamentosa does not appear to be very closely related to any of the described species of this chiefly Australian genus. The only other species to which monosiphonous filaments are attributed are, so far as we can discover, the Australian *Sarcomenia tenera* (Harv.) J. Ag., *S. dolichocystidea* J. Ag., *S. opposita* J. Ag. and *S. secundata* J. Ag., but these are all much coarser plants with Dasyoid or Cliftonioid rather than Polysiphonioid habit, and the origin and arrangement of the branchlets and monosiphonous filaments are more or less different in all of these. In its delicate Polysiphonioid habit, *S. filamentosa* is nearer the group which includes *S. miniata* (Ag.) J. Ag. (the type of which we have seen in hb. Agardh), *S. intermedia* Grunow, and *S. mutabilis* (Harv.) J. Ag., but these differ not only in absence of monosiphonous filaments, but also in cortex characters, etc.; in *S. mutabilis*, also, the branches have a marginal or submarginal instead of mid-ventral origin.

The apparent incongruity of referring delicate plants of the *miniata* type to a genus originally based upon the fleshy membranous *Sarcomenia delesserioides* has already been remarked by Grunow * and discussed at length by J. Agardh.† In placing the above-described new species in *Sarcomenia*, we accept, for the present, the current conception of the limits of the genus.

The plant changes color and partially decomposes very soon after being collected, even though placed in a moderate amount of sea-water. It adheres most firmly to paper on drying yet recovers its form well on being soaked out if the material was originally good and properly prepared.

Dudresnaya crassa sp. nov.

Rose-colored when living, dingy-purple or brownish-red on drying, densely ramose, lubricous, subpyramidal in contour, 6–8 cm. high, the primary branches appearing irregularly 1–2-pinnate when pressed on paper, the secondary and tertiary branches then mostly confluent, unequal in length, vermiform, apices obtuse; branches of all orders of nearly uniform diameter throughout, 1–2 mm. thick in natural state, 1.5–3 mm. after pressure, all parts very closely adherent to paper: monosiphonous axis much obscured by the very numerous decurrent filaments, its cells 2–8 times longer than broad; peripheral filaments 4–6 times dichotomous, beautifully fastigiate, 0.5–0.8 mm. long, scarcely constricted at the joints, 5–6 μ in diameter, the more peripheral cells 2–5 times as long as broad: carpogonial branch simple, consisting of 5–19 subspherical or somewhat discoid cells in a single series, its apex slightly deflexed and terminating in the much elongated, curved or nearly straight trichogyne; auxiliary-cell branches numerous, consisting of 5–9 enlarged subspherical or oblate-ellipsoidal cells near base, terminating in a multiarticulate prolongation similar to that of the other peripheral filaments or often shorter; auxiliary-cell occupying the middle of the enlarged portion of the branch and having little more than half the diameter of the two immediately adjacent cells, the latter much inflated, rich in contents, 15–30 μ in transverse diameter: cystocarps 0.12–0.24 mm. in diameter, often 2–4-lobed: antheridia and tetrasporangia unknown. [Plate 28; plate 29, figures 12–26.]

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* Reise seiner Majestät Fregatte Novara um die Erde. Bot. Theil **1**: 93. 1867.

† Anal. Alg. Cont. **5**: 130. 1899.

On rocks in 3 m. of water (low tide), Castle Harbor, Bermuda: *no. 315*, type (6 July 1900, M. A. H.); also a floating fragment at Spanish Point, Bermuda, *no. 198*.

Dudresnaya crassa is nearest allied to *D. coccinea* (Ag.) Crouan in the structure of the carpogonial branch and the auxiliary-cell apparatus and in the elongated cells of the peripheral filaments, but is very different in size and habit, in the obtuse ultimate branches which have nearly the diameter of the primary, in having its peripheral filaments 2–4 times as long as in *D. coccinea*, and in the highly specialized auxiliary-cell, which is always much smaller than the conspicuously enlarged adjacent cells. Thuret states* that in *D. coccinea* the branches which bear the antheridia occur on the same plants that bear the cystocarps; in *D. crassa*, the antheridia have been searched for in vain on the cystocarpic individuals — the only sort collected — and the species is believed to be dioicous. In its dense habit of branching, the species bears a closer superficial resemblance to *D. purpurifera* J. Ag., though the branches are obtuse and coarser; however, in structure of the carpogonial branch and the auxiliary-cell apparatus † and in the character of the peripheral filaments, it differs so widely that no detailed comparison is necessary.

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* Bornet & Thuret, Notes Algologiques, 36. 1876.

† See Oltmanns, Morphologie und Biologie der Algen 1: 688–691. *f. 441a, 441.* 1904.

The only specimen from the American side of the Atlantic which has heretofore been referred to the genus *Dudresnaya* is, so far as we know, one collected in the Tortugas, Florida, by Mrs. G. A. Hall and described as new by J. Agardh in 1899 under the name "*Dudresnaja canescens*" (Anal. Alg. Cont. **5**: 88). This, however, is a plant of entirely different habit from ours and is not a *Dudresnaya*, as a recent examination of the single type-specimen in hb. Agardh has shown.

The auxiliary-cell branches and cystocarps are very abundant in our material and we have been able to observe nearly all stages in their development and mutual relations, though without any serious attempt to study the internal cytological changes. In their general features, the fusion of the sporogenous filament and the auxiliary-cell and the subsequent development of the cystocarp take place very much as described and figured for *D. coccinea* by Bornet and Thuret and by Oltmanns. However, Thuret's description (*l. c.*) gives the impression that the fusion can take place with any one of three similarly enlarged cells of the auxiliary branch, while in *D. crassa* it seems always to occur with a single definite highly specialized cell lying between the two larger ones. The content of this cell appears at first very much like that of the adjacent cells, but as it matures it undergoes a change, becoming more homogeneous and translucent; at the same time the auxiliary-cell and the two neighboring cells become enveloped in an especially thick layer of mucus which stains yellowish with safranin. We regret that the behavior of the carpogonial branch after fertilization has escaped observation in this species. Carpogonia occur in moderate number in our material (we have seen 25 or 30), but all seemed unfertilized; and the sporogenous filaments travel such long distances that we have failed in attempts to trace them back to their ultimate source.

The type-specimen — *no. 315* — is associated with a *Chantransia*, which permeates it, more or less, and fringes its surface.

C. MISCELLANEOUS NOTES

CAULERPA CRASSIFOLIA (Ag.) J. Ag. Till Alg. Syst. **1**: 13. 1872

Caulerpa taxifolia β crassifolia Ag. Sp. Alg. **1**: 436. 1822. (Excluding synonymy.)

Caulerpa pinnata Web.-v. Bosse, Ann. Jard. Bot. Buitenzorg **15**: 289. 1898. Not *Fucus pinnatus* L. fil. Suppl. 452. 1781.

Under the name *Fucus pinnatus* * in the Linnaean herbarium, now in possession of the Linnean Society of London, is a single sheet of four or five fragmentary specimens which agree with the somewhat detailed original description sufficiently well to leave no reasonable doubt that they represent the type material of that species. The natural form of the plant is somewhat modified by drying and pressure, yet it is evident that the pinnules are cylindrical (or clavate), as afterwards figured and described by Turner (Hist. Fuc. **1**: 117. *pl. 53.*) and that the plant belongs in the section *Sedoideae* (J. Ag.) of *Caulerpa*, being close to *C. racemosa corynephora* (Mont.) Web.-v. Bosse.† In the younger parts of the specimens the pinnules are distinctly inflated at their apices and are less regularly distichous; it is probable that this character suggested the Linnaean words which puzzled Turner: "Inflorescentia est racemus ex verticillis cum fructificationibus pedicellatis, peltatis, planis."

Madame Weber in her scholarly "Monographie des Caulerpes" refers to an authentic specimen of the *Fucus pinnatus* of Turner in the herbarium of the British Museum. This specimen of Turner's we have not seen, but if it belongs to the Filicoid rather than the Sedoid group, the apparent disagreement with Turner's description and figure should suggest doubts as to its authenticity or suggest the possibility that Turner's material was mixed. In any event, the true type of *Fucus pinnatus* L. fil. should be sought in the Linnaean herbarium rather than in that of the British Museum.

In the Agardh herbarium at Lund are two specimens which, judging from the original citation, probably served as originals of the "*Caulerpa taxifolia β crassifolia.*" Of these only one is actually associated with the name *crassifolia*; this is a fragment in a pocket inscribed "Caul. taxifolia var. crassifolia Ag. e mari Antillarum mis. Sprengel." This is suggestive of the familiar figure of *C. crassifolia* given in the Pflanzenfamilien of Engler and Prantl, and attributed to Sachs, except that the pinnules are scarcely narrowed at the base and are of course flatter than indicated in that figure. The second specimen — which is of the same species — is marked "Fucus taxifolius Vahl variet. C. M. 1821. ex Ind. occ." The "In mari Indico & rubro" habitat, also cited by C. Agardh in his original publication of "*β crassifolia*" was evidently derived from the erroneously identified *Fucus pinnatus* of Linnaeus fil. and of Turner, which he cites as a synonym. J. Agardh apparently had become suspicious of the alleged synonymy, for (Till Alg. Syst. **1**: 14) he remarks, "utrum synonyma ibidem allata * * * ad eandem pertineant, dicere non auderem."

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* Mr. B. Daydon Jackson informs me that the handwriting is that of the younger Linnaeus, whom he considers to be the real author of the "Supplementum."

† Ann. Jard. Bot. Buitenzorg **15**: 360, 364. *pl. 33. f. 10–13.* 1898.

Caulerpa sertularioides (S. G. Gmel.)

Fucus sertularioides S. G. Gmel. Hist. Fuc. 151. *pl. 15. f. 4.* 1768.

Fucus plumaris Forsk. Fl. Aegypt.-Arab. 190. 1775.

Caulerpa plumaris Ag. Sp. Alg. **1**: 436. 1822. — J. Ag. Till Alg. Syst. **1**: 15. 1872. — Web.-v. Bosse, Ann. Jard. Bot. Buitenzorg **15**: 294. 1898.

That Gmelin's *Fucus sertularioides* is the same as the plant commonly known as *Caulerpa plumaris* is admitted by J. Agardh and, more recently, by Madame Weber-van Bosse. Gmelin's figure and description seem sufficiently conclusive; his plant was American ("in corallis americanis"), though no definite locality is given. The rulings of the recent International Botanical Congress at Vienna, though professedly applying only to the spermatophytes and pteridophytes, are explicit as to the maintenance of the oldest specific name.

Acetabulum Farlowii (Solms)

Acetabularia Farlowii Solms, Trans. Linn. Soc. Bot. II. **5**: 27. *pl. 3. f. 1.* 1895.

This species was founded upon three somewhat imperfect plants sent by Farlow to Thuret. In the place of publication the material is said to have come from the "southern point of Florida, Key West," but Professor Farlow writes us that the alga was collected in Biscayne Bay, Florida, by Dr. E. Palmer in 1874. At the close of the original description, which was necessarily brief from lack of material, Count Solms expresses the hope "that this remarkable plant will be found again soon."

On November 11, 1902, the writer found on the northeastern shore of the island of Key West, a considerable quantity of a handsome little *Acetabulum* growing attached to shells, stones, broken pieces of coral, etc., at just about the low-water line and rather closely confined to this zone. Adjacent, in water that was from 1 to 10 dm. deep at low tide, and occasionally approaching and intermingling with the lower-growing individuals of this small green *Acetabulum*, were numerous clusters of the larger, whiter, more rigid, and more strongly calcified *Acetabulum crenulatum* (Lamour.) Kuntze. A hand-lens showed the strong cusp or apiculum with which each ray of the disc in *A. crenulatum* always terminates in in the younger stages at least, while the rays in the smaller species appeared to be entirely destitute of an apiculum even in the youngest conditions that could be observed at the time. Confident that two species were represented by the specimens growing at this point and finding on returning to New York that the smaller plant evidently had much in common with the *Acetabularia Farlowii* as described and figured by Solms, we submitted specimens of it both to Count Solms and Professor Farlow, both of whom approved the reference to *A. Farlowii*, though with a certain amount of cautious reserve in view of the scantiness of the original material.

In March 1904, the writer again found *Acetabulum Farlowii* in abundance, this time at Miami, Florida, and at Cutler, both on Biscayne Bay. Here again, the *A. Farlowii* was confined to a rather narrow zone near the low-water mark, while *A. crenulatum* (which in Biscayne Bay is more profusely abundant than we have yet seen it elsewhere), with a wider range, had its best development in deeper water (best in 3 dm. to 4 m., low tide). The zones occupied by the two species occasionally, however, overlapped; the individuals intermingling in this common region were, as a rule, easily referred at sight to the one species or the other, though once in a while an individual was met with whose affinities seemed at first a little dubious. Yet we believe that the two are actually and always distinct and distinguishable and that the principal diagnostic characters may be contrasted as follows:

Acetabulum crenulatum	*Acetabulum Farlowii*
Discs usually well-calcified and whitish on drying, often 2 or 3 superposed, commonly infundibuliform or cyathiform, 5–15 mm. broad; sporangia (rays) mostly 35–60, persistently coherent, strongly apiculate in early stages, the apiculum sometimes obscure with age; aplanospores 200–500 to a sporangium.	Discs lightly calcified, green on drying, solitary, nearly plane, 4–7.5 mm. broad; sporangia (rays) mostly 20–30, lightly coherent or often separate and free, rounded-obtuse or truncate at apex from an extremely early stage; aplanospores 40–120 to a sporangium.

The feature in which, chiefly, the original description given by Solms needs amendment is in regard to the coherence of the rays. *A. Farlowii* was placed by Solms in a group with *A. Calyculus* under the caption "Rays even in the living state separate and free." An examination of some thousands of individuals in the living state leads us to the opinion that only about one in four or one in five has the rays separate and free. However, clusters of plants are found in which the rays of nearly every disc are discrete; other clusters in which the rays nearly always remain coherent, forming discs that are slightly concave or almost plane. In some cases, the rays are apparently discrete from the first; in others, they have probably become more or less separated by mechanical agencies.

Specimens of *Acetabulum Farlowii* obtained by the writer at Key West under the collection number *1676* were distributed in the Phycotheca Boreali-Americana as *no. 1032*. We have not met with the species in the Bahama Islands; so far as known, it is confined to southern Florida.

BATOPHORA OERSTEDI J. Ag. Öfvers. Kongl. Vet.-Akad. Förh. **11**: 108. 1854.

Dasycladus Conquerantii Crouan; Schramm & Mazé, Essai Classif. Alg. Guadeloupe, 47. 1865. — Mazé & Schramm, Essai Classif. Alg. Guadeloupe, 108. 1870–77. [According to specimens in hb. Mus. Paris., and hb. Mus. Brit., distributed by Mazé and by Mazé & Schramm.]

Botryophora Conquerantii Cramer, Neue Denkschr. Schweiz. Naturf. Ges. **32**: 6. *pl. 4. f. 1.* 1890.

Coccocladus occidentalis Conquerantii M. A. Howe, Bull. Torrey Club **31**: 96. 1904.
Coccocladus occidentalis laxus M. A. Howe, *l. c.* 95. *pl. 6. f. 1, 2.*

Batophora Oerstedi occidentalis (Harv.)

Dasycladus occidentalis Harv. Ner. Bor.-Am. **3**: 38. *pl. 41B.* 1858.
Botryophora occidentalis J. Ag. Till Alg. Syst. **5**: 141. 1887.
Coccocladus occidentalis Cramer, Neue Denkschr. Schweiz. Naturf. Ges. **30**: — (37). 1887.

The discovery that *Batophora Oerstedi* was published by J. Agardh four years previously to Harvey's *Dasycladus occidentalis*, and that it was apparently forgotten even by J. Agardh himself, is a good illustration of the surprises which must now and then await any one who is partial to the cause of priority in botanical nomenclature. In 1854 J. Agardh published a very full description both of "*Batophora*, J. Ag. mscr. Gen. nov. ex Siphonearum familia inter Oliviam et Dasycladum intermedium" (*l. c.* 107) and of its single species, *Batophora Oerstedi*, "Hab. ad radices Rhizophorae Mangle in sinu substagnante 'Krauses lagoon' dicto, ad Insulam St. Crucis: Oersted." In 1887, in publishing "Botryophora J. Ag. mscr.," he alludes to his already having designated the plant *Botryophora Oerstedi* in a collection of algae made by Oersted, even before Harvey published *Dasycladus occidentalis*, but there is no reference to his having already actually printed a description of the proposed new genus under a somewhat different generic name and this fact appears to have been overlooked, so far as we can discover, by all subsequent phycologists and bibliographers. If any evidence were needed that this omission on the part of Agardh was due simply to a lapse of memory and not to any intent to ignore, it would be furnished by his attitude toward certain other species and names published in the same paper.*

Possibly it may be objected that "Batophora" is a misprint for the "Botryophora" of thirty-three years later. To this it may be replied that "Batophora" is well formed etymologically, is fully as significant and appropriate as "Botryophora," and in the Agardh herbarium the name *Batophora Oerstedi* appears in connection with one of Oersted's specimens.

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* *E. g.*, *Bryopsis Duchassaingii* J. Ag. Öfvers. Kongl. Vet.-Akad. Förh. **11**: 107. 1854. — "Hoc nusquam a me publici juris factum, jamdudum oblitum credidissem" (Till Alg. Syst. **5**: 31. 1887).

In the Agardh herbarium are several small sheets of specimens which probably served as the original materials of *Batophora Oerstedi.* Three of these are fastened to a larger sheet; the others are loose in another cover with a loose label. Only one (one of the fastened sheets) has an individual inscription and this is inscribed simply "*Batophora Oerstedi.*" The specimens illustrate the condition of the species which is found in quiet and often merely brackish water — a condition characterized by large size, lax habit, and obovoid or oblong-ellipsoidal sporangia, which occur at the ends of the branches of the first three orders. *Coccocladus occidentalis laxus* M. A. Howe is a form that is very common in the Bahama Islands, growing in interior ponds of which the nearly fresh water responds only slightly to the changes of the tides — often associated in about equal abundance with *Chara Hornemanni* and *Ruppia maritima.* Since seeing authentic material of *Batophora Oerstedi* and *Dasycladus Conquerantii* and since studying these plants in the living condition on two visits to the Bahamas, we hardly think it worth while to maintain the subspecific name *laxa.* The contrast in size and habit and in form and position of sporangia, between the lax plants of the interior brackish ponds and the condensed ones of the border of the open ocean (here placed under the subspecific name *occidentalis*) is remarkably striking, yet the peculiarities of each, we believe, are directly connected with the degree of salinity and quietness of the water. Intermediate forms occur in places of intermediate character.

NEOMERIS COKERI M. A. Howe, Bull. Torrey Club **31**: 97. *pl. 6. f. 3–12.* 1904

This strongly marked species, described from material collected by Professor Coker in 1903, on the island of Eleuthera, Bahamas, is not uncommon throughout the Bahamian archipelago, ranging at least from the Great Bahama on the north to the Great Exuma on the south. Its usual habitat is under shelving rocks near the low-water line. The original description was based on rather small individuals having a length or height of 7–14 mm.

A maximum height of 37 mm. has since been observed and the spores are sometimes oblong-ellipsoidal instead of obovoid.

FUCUS SPIRALIS L. Sp. Pl. 1159. 1753

The above name has now and then since the time of Linnaeus been applied by European writers to certain forms of North European rockweeds representing doubtless two species, the one always synoicous, the other a condition of the always dioicous *F. vesiculosus*. In America, the name has had little vogue, except as used by Farlow* and others for a variety of *F. vesiculosus*, without citation of Linnaeus. In 1883, Kjellman in "The Algae of the Arctic Sea" † definitely recognized *Fucus spiralis* L. as a species, though in 1890 ‡ he renamed the species *Fucus Areschougii* Kjellm., having apparently become doubtful as to the identity of the Linnaean plant. De-Toni §, however, a little later, quotes *F. Areschougii* as a synonym of *F. spiralis* L. without any indications of doubt, and more recently Börgesen || has given a detailed discussion of the subject, in which he considers not only *F. Areschougii* Kjellm. but also *F. platycarpus* Thuret to be synonyms of *F. spiralis* L. Börgesen's determination of *Fucus spiralis* rests chiefly on the Linnaean descriptions. As is well known, the comparatively modern idea of nomenclatorial type-specimens was not recognized by Linnaeus, and the herbarium that he left is not always satisfactory or conclusive to the one who would see the materials that he actually had before him in writing his descriptions. Nevertheless, the specimens in the Linnaean herbarium to which we may believe Linnaeus himself attached the name *spiralis* are of much interest in this connection and it may be said that they seem to support Börgesen's position. There are under this name in the Linnaean herbarium, which we were permitted to examine through the courtesy of Mr. B. Daydon Jackson, two specimens fastened to separate sheets, each inscribed at the bottom "4 spiralis" in Linnaeus' hand. Both specimens are fertile and both are without vesicles. The wholly justifiable restrictions placed

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* Mar. Alg. N. E. 101. 1881. — Farl. And. & Eat. Alg. Exsic. Am. Bor. *109 bis*.

† Kongl. Sv. Vet.-Akad. Handl. **20**^{5}: 202.

‡ Handb. Skand. Hafsalgflora, 11.

§ Syll. Alg. **3**: 207. 1895.

|| Mar. Alg. Faeröes, 472–477. 1902.

upon the use of this historic collection did not permit any attempts to determine whether the plants are synoicous or dioicous, but one, at least, of the two, is, in our opinion, very clearly a rather small specimen of the typical *Fucus Areschougii* Kjellm. This specimen is 10 cm. high, the branches are somewhat contorted and 4–6 mm. broad above, the distinct costa alone persisting in most of the lower half; the receptacles are ovate, obovate or suborbicular, and 5–8 mm. long. It evidently represents a form of the synoicous species which on the eastern coast of North America is common from Maine to Newfoundland and doubtless ranges farther north; it is confined to a rather narrow zone near the high-water mark. Specimens illustrating this form from Cape Rosier, Maine, were issued as *no. 234* of the Phycotheca Boreali-Americana of Collins, Holden & Setchell under the name *Fucus Areschougii* Kjellm. The other Linnaean specimen cannot be so confidently determined without dissection, yet we have little doubt that it also represents a condition of the same synoicous species. This is a larger, uncontorted plant, with more elongated receptacles and more conspicuous cryptostomata, and the wings are more persistent below; it is about 20 cm. high, the even-topped branches are 4–8 mm. wide, the verrucose receptacles are 8–20 mm. long, mostly 2–3 times as long as wide, though one or two are suborbicular. This appears to exemplify a form of the species which in North America is rather more southern in its range than the other, being not uncommon near the high-tide line in Long Island Sound within the limits of New York City. This more southern form occasionally approaches *Fucus platycarpus* Thuret in habit, and specimens from Marblehead Neck, Massachusetts, were distributed under that name in the Phycotheca Boreali-Americana, *no. 1132*; however, we have seen no American specimens in which the receptacles are as pronouncedly lateral as in the typical *F. platycarpus* of northern France. The larger forms of *Fucus spiralis* are sometimes imitated by certain evesiculose conditions of *F. vesiculosus*, but can be distinguished by being always synoicous and usually also at sight by having more strongly verrucose and more margined receptacles. It grows typically in a higher zone on the rocks than does *F. vesiculosus*. Vesicular inflations are occasionally present, but they are much elongated and irregular in form and position.

It is of interest to add that the writer has sent photographs of the two Linnaean specimens of *Fucus spiralis* to Dr. Börgesen, who writes: "One of them is a true *Fucus spiralis* (= *F. Areschougii* Kjellm.), the other is a little dubious, it may be *Fucus spiralis*, but it also very well may be a form of *Fucus inflatus*."

FUCUS POITEI Lamour. Diss. 63. *pl. 31. f. 2, 3.* 1805

That the *Fucus Poitei* of Lamouroux was a *Laurencia* seems to have been suspected first by the keen-eyed Kützing.[*] J. Agardh, a little later, judging, as would appear from his discussion, only from Lamouroux's description and figures (and possibly somewhat influenced by the fact that Lamouroux in 1813 placed the plant in *Chondrus* instead of in *Laurencia*), referred this *Fucus Poitei* to the very different genus *Gracilaria* and expressed his confidence in the correctness of this determination by writing an exclamation mark after the citation. Since that time, so far as we can discover, this determination has not been questioned and "*Gracilaria Poitei* (Lamour.) J. Ag." has held a place in general monographs and in special papers relating to West Indian algae.

In the herbarium of Lamouroux at Caen, which we had the privilege of seeing in the summer of 1904 through the courtesy of Professor Octave Lignier, there are in the cover devoted to this species a single small mounted specimen (4 cm. high, 6.5 cm. broad), two loose fragments, a loose slip of paper inscribed "fucus poitei" in the handwriting of Lamouroux, and two drawings marked "fig. 3" and "fig. 4$^{\text{me}}$." Fig. 3 was published as *f. 2*; fig. 4$^{\text{me}}$ as *f. 3*. The specimens, which Lamouroux's good diagnosis and rather poor figures allow us to assume, with much confidence, to be parts of the original, belong to the genus *Laurencia* and to the common West Indian species described by J. Agardh under the name *L. tuberculosa*[†] and afterwards figured and described by Kützing as *L. mexicana*.[‡]

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[*] Species Algarum, 857. 1849.

[†] Sp. Alg. **2**: 760. 1852.

[‡] Tab. Phyc. **15**: 25. *pl. 70. f. c. d.* 1865.

Explanation of plates 23-29

PLATE 23

1. *Avrainvillea levis.* Photograph of two dried specimens (*no. 3996*, type —, Cave Cays, Exuma Chain, Bahamas, 19 F 1905, M. A. H.), natural size.

2. *Halimeda favulosa.* Photograph of about one half of one segment of a dried specimen (from *no. 3981*, type), magnified sixteen diameters.

PLATE 24. *Halimeda favulosa*

Photograph of dried specimen (*no. 3981*, type —, Cave Cays, Exuma Chain, Bahamas, 19 F 1905, M. A. H.), reduced to about two-thirds the natural dimensions.

PLATE 25. *Cladocephalus scoparius*

Photograph of formalin-preserved specimens (*no. 4079*, type —, Georgetown, Great Exuma, Bahamas, 24 F 1905, M. A. H.), natural size. The young plant at the right with the truncate apex shows only the beginning of the differentiation of the capitulum; the other two short plants represent later, though still very immature, stages in the development of the capitulum — in one the stipe is furcate above, the two branches again coalescing; the three largest specimens are typical full-grown plants.

PLATE 26

1–6. *Halimeda favulosa*

1–3. Peripheral utricles, decalcified, in lateral view.

4. Peripheral utricles with dense granular content (see page 565).

5. Peripheral utricles in surface view, decalcified.

6. Filaments of the central strand, showing mode of union at the nodes.

Figures 1–6 are all enlarged 40 diameters and are all drawn from the type material, *no. 3981* (Cave Cays, Exuma Chain, Bahamas).

7. *Halimeda tridens*

7. Peripheral utricles, decalcified, in lateral view, × 40. Introduced for comparison with *H. favulosa*.

8–10. *Avrainvillea levis*

8. One of the larger filaments from the flabellum, with dichotomy.

9. A filament of the usual size, from flabellum.

10. A filament from apical margin of flabellum, with wide-angled dichotomy.

Figures 8–10 are all enlarged 150 diameters; 8 and 9 are drawn from the type material, *no. 3996* (Cave Cays, Exuma Chain, Bahamas); 10, from *no. 3966*.

11–20. *Cladocephalus scoparius*

11. One of the main branches of the capitulum, showing ramification, natural size. The left-hand side was toward the middle of the capitulum.

12. A detail of the branching of the capitulum, showing anastomoses, × 2.

13. Cross-sections of branches of the capitulum, × 4.

14. Fragment of a branch of the capitulum in surface view with part of cortex removed, disclosing medullary filaments, × 55.

15. Medullary filament from apex of capitulum, × 55. The branch at the left, now becoming lateral, represents the beginning of the cortical system.

16. The branch at the right represents a later stage in the development of the cortex, × 55.

17. Cross-section of stipe, × 4.

18. Cortical region of stipe in cross-section, × 150. Drawn from a microtome section 20 μ in thickness.

19. A stage in the differentiation of the cortical filaments later than that shown in figure 16, × 55.

20. Final form of cortical filaments of capitulum, × 150.

Figures 11–20 are drawn from formalin-preserved material of the type, *no. 4079* (Georgetown, Great Exuma, Bahamas).

PLATE 27. *Sarcomenia filamentosa*

Photograph of dried specimen (*no. 2844*, type —, Cape Florida, 29 Mr 1904, M. A. H.) attached to *Sargassum*, natural size.

PLATE 28. *Dudresnaya crassa*

Photograph of dried specimen (*no. 315*, type —, Castle Harbor, Bermuda, 6 Jl 1900, M. A. H.), natural size.

PLATE 29

1–11. *Sarcomenia filamentosa*

1. Apex of polysiphonous branchlet, ventral view, showing apical cell and origin of the paired marginal cells and of the monosiphonous filaments, × 193.

2. Older part of branchlet, dorsal view, × 193.

3 and 4. Cross sections of uncorticated branchlets, ventral side downward, × 193.

5. Apical portion of uncorticated branchlet, with the unifarious monosiphonous filaments, × 48.

6. Branchlet viewed from margin, showing bases of the monosiphonous filaments, × 193.

7. Part of an older branch, ventral view, showing origin of polysiphonous branchlet (really from axial siphon), × 44. Marginal cells at somewhat regular intervals are enlarged and protuberant (potentially rhizoids). The monosiphonous filaments have here disappeared, but the cell cut off from the anterior end of the ventral siphon marks their former position in each thallus-segment. Small intercalary cells, originating chiefly from the pericentral siphons, constitute the beginning of the cortex.

8. A similar branch, dorsal view, × 44. The rhizoids are here growing out.

9. Surface view near the base of one of the largest stems seen, showing cortical cells, × 40.

10. Cross-section of a similar main stem × 44.

11. Cross-section of an ordinary main axis in the basal third of the plant, × 44.

Figures 9 and 10 are drawn from our *no. 2860*; figures 1–9, and 11 are from the type material, *no. 2844* (Cape Florida).

12–26. *Dudresnaya crassa*

12. Outer portion of peripheral filament.

13–15. Carpogonial branches.

16 and 17. Auxiliary-cell branches; auxiliary-cell occupying middle of enlarged portion, lying between two much larger cells.

18–22. Fusion of sporogenous filament with auxiliary-cells; in figure 21, two cells (indicated by dotted lines) appear in the position formerly occupied by the auxiliary-cells; in figure 22, three cells occupy this position — the protruding one at the left will form the main body of the cystocarp or one lobe of it.

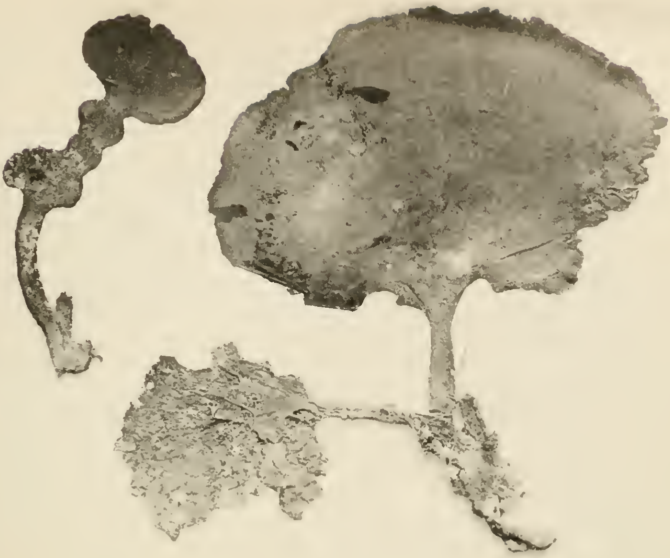
23–26. Cystocarps, showing relation to original auxiliary-cell branch and to the sporogenous filaments. The small peduncled cystocarp, developed at some distance from the original auxiliary-cell, shown in figure 26, is abnormal. Figures 24 and 25 show mature cystocarps, the one unilateral, the other more symmetrical and 3-lobed.

Figures 12–26 are all enlarged 193 diameters and are all drawn from the type material, *no. 315* (Castle Harbor, Bermuda). The outer limits of the gelatinous cell-walls are scarcely visible except by staining and the lines as drawn give an exaggerated idea of their distinctness.

Addendum

While this paper is going through the press and is in the paged-proof stage, an opportune communication from Mr. J. R. Tovey, acting curator of the National Herbarium of Victoria, Australia, reaches us, enclosing a portion of the original specimen of Kützing's *Halimeda brevicaulis*, a species which is discussed on page 564. As is true in the case of several other species, Kützing evidently saw the plant in "Herb. Sonder," which is now in the possession of the National Herbarium of Victoria. The label of the specimen in question, a transcription of which we owe to the kindness of Mr. Tovey, reads, "*Halimeda brevicaulis* Kuetz. Tab. Phyc. VIII. tab. 25. India occidental." In the place of original publication, the locality is given as "Bahamas-Inseln," but the fragment sent by Mr. Tovey is manifestly the very one sketched by Kützing in his figure *b*. The plant is not *Halimeda favulosa*; as already surmised (page 564), it is probably to be considered a lax flaccid condition of *H. tridens* (*H. incrassata*). The peripheral utricles, however, are rather larger than is usual in *H. tridens*, measuring 50–80 μ in diameter in surface view; the filaments of the central strand cohere at the nodes.

Mr. Tovey kindly sends us also fragments of the flabellum and stipe of Kützing's *Rhipilia longicaulis*, to which we have alluded on pages 567 and 568. These indicate clearly, we think, that the species is the same as the more recently published *Avrainvillea Mazei* Murr. & Boodle. The filaments of the flabellum are now and then slightly torulose, but they are mostly cylindrical without constrictions, except for the strong one where they leave the dichotomy; the ends of some of the branches are thin-walled and shriveled, but they are not destitute of chlorophyl and should not be considered hairs.



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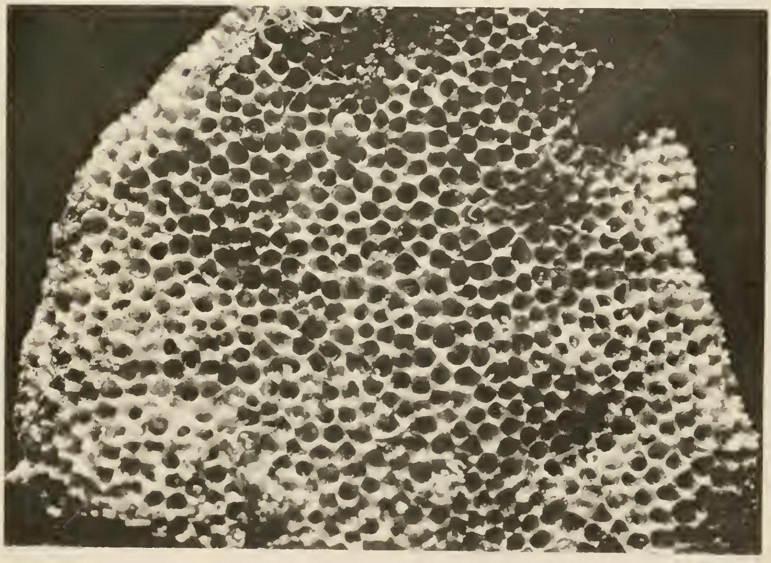

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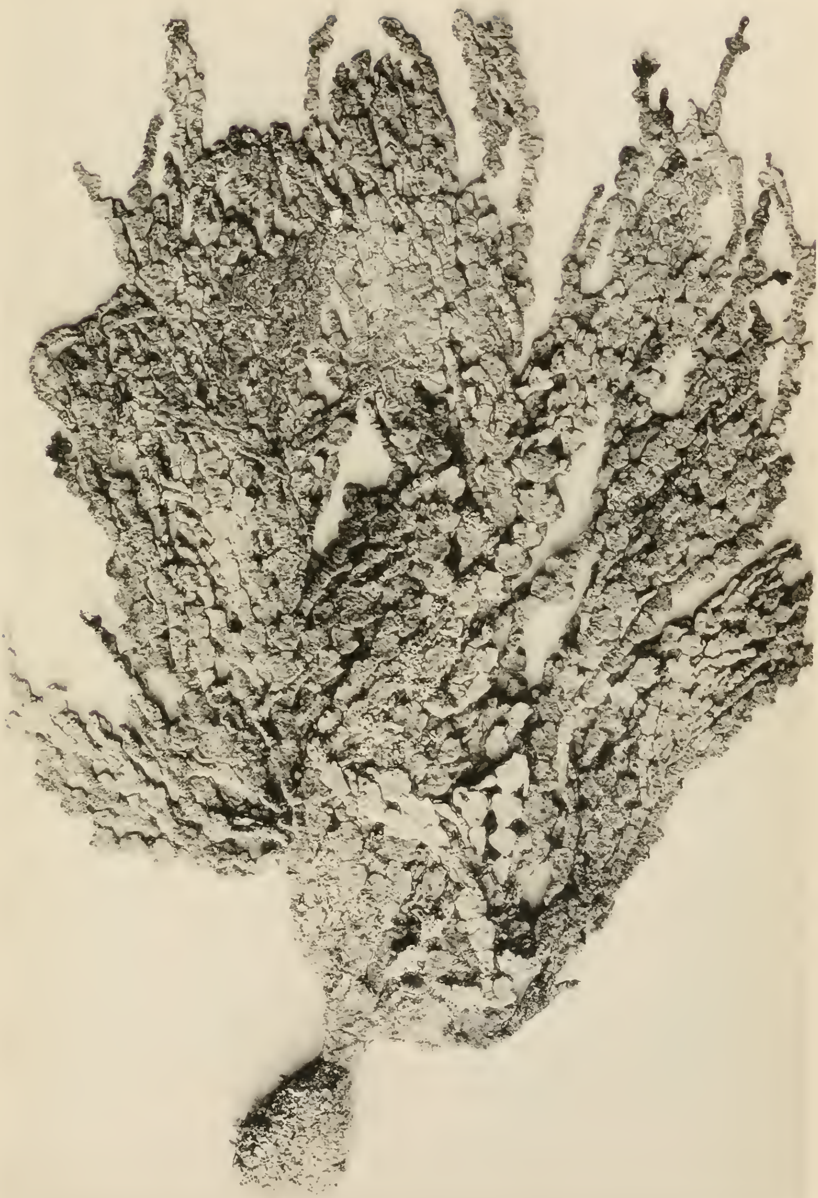
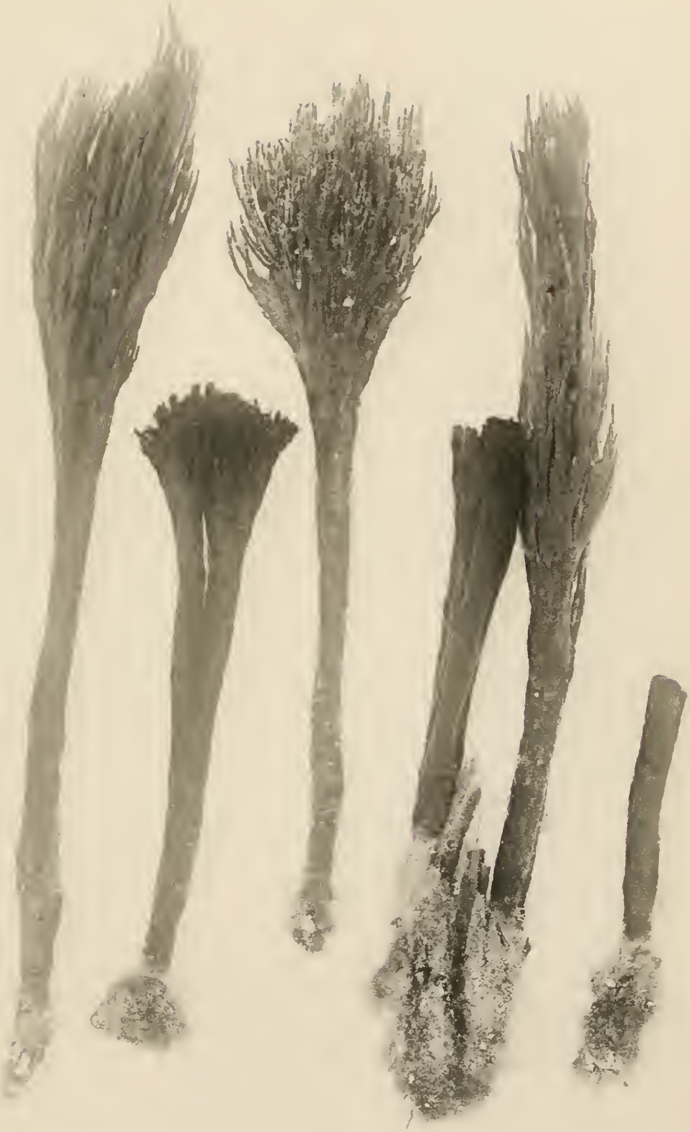
1. AVRAINVILLEA LEVIS M. A. Howe

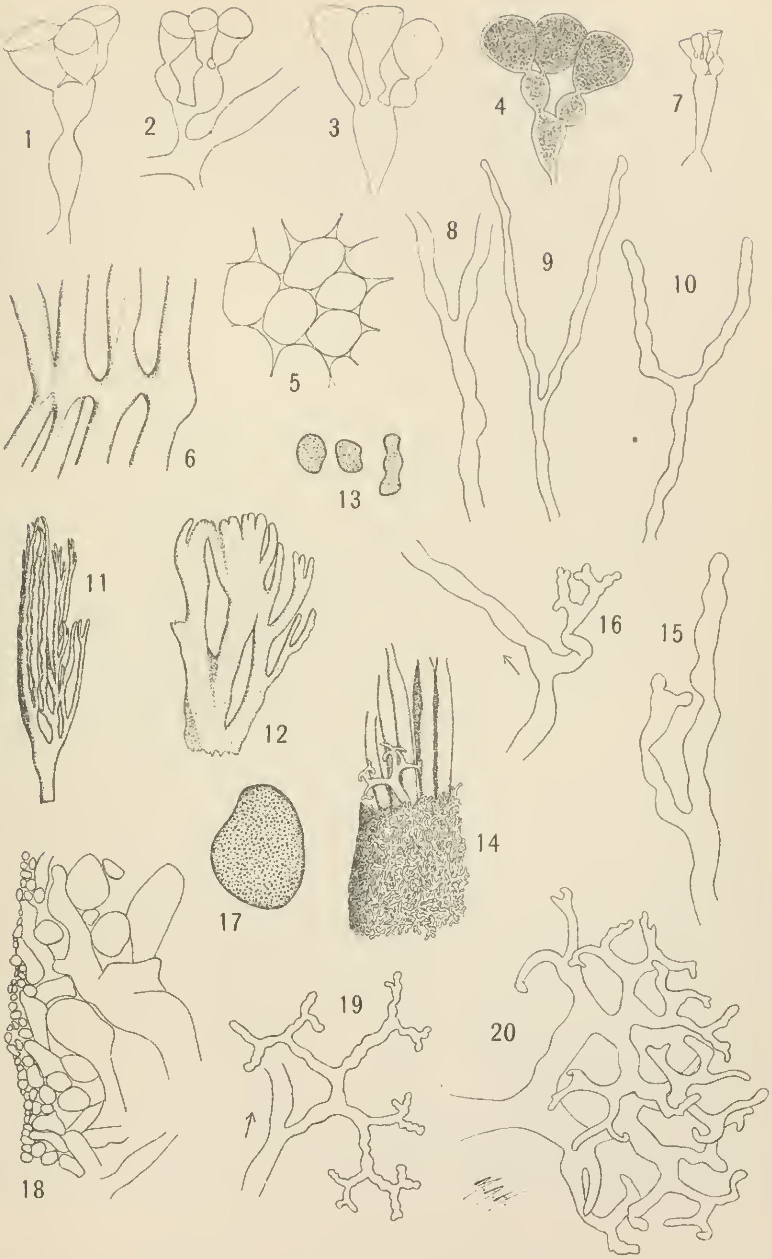
2. HALIMEDA FAVULOSA M. A. Howe



HALIMEDA FAVULOSA M. A. Howe



CLADOCEPHALUS SCOPARIUS M. A. Howe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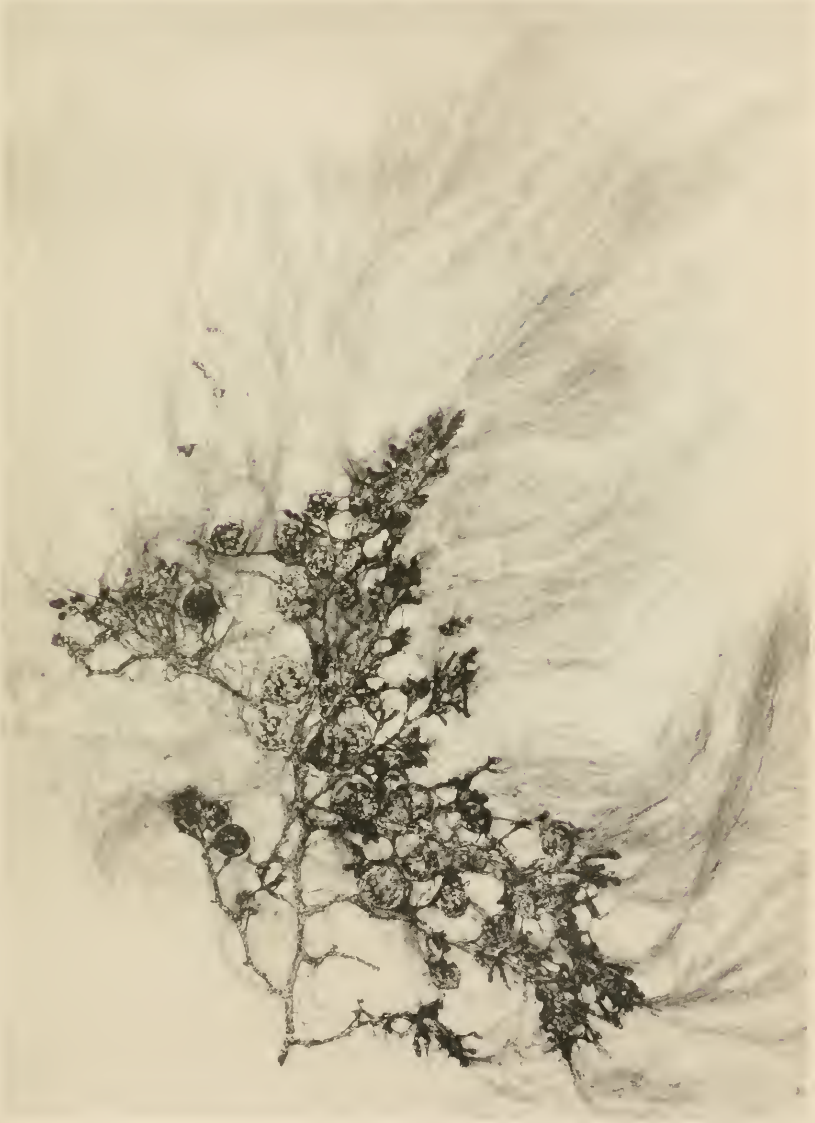
1-6. HALIMEDA FAVULOSA M. A. Howe

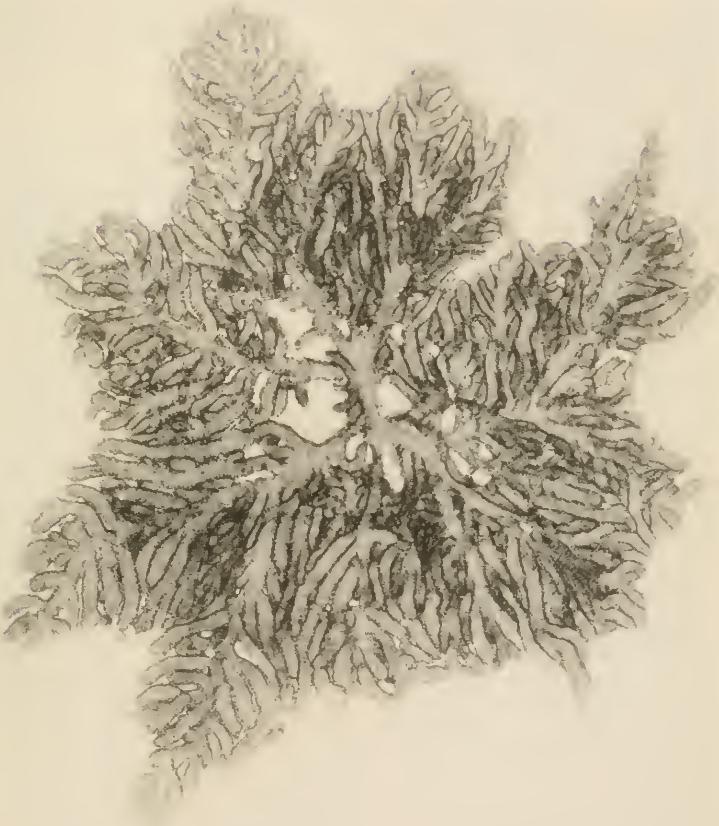
7. HALIMEDA TRIDENS (Ell. & Soland.) Lamour.

8-10. AVRAINVILLEA LEVIS M. A. Howe

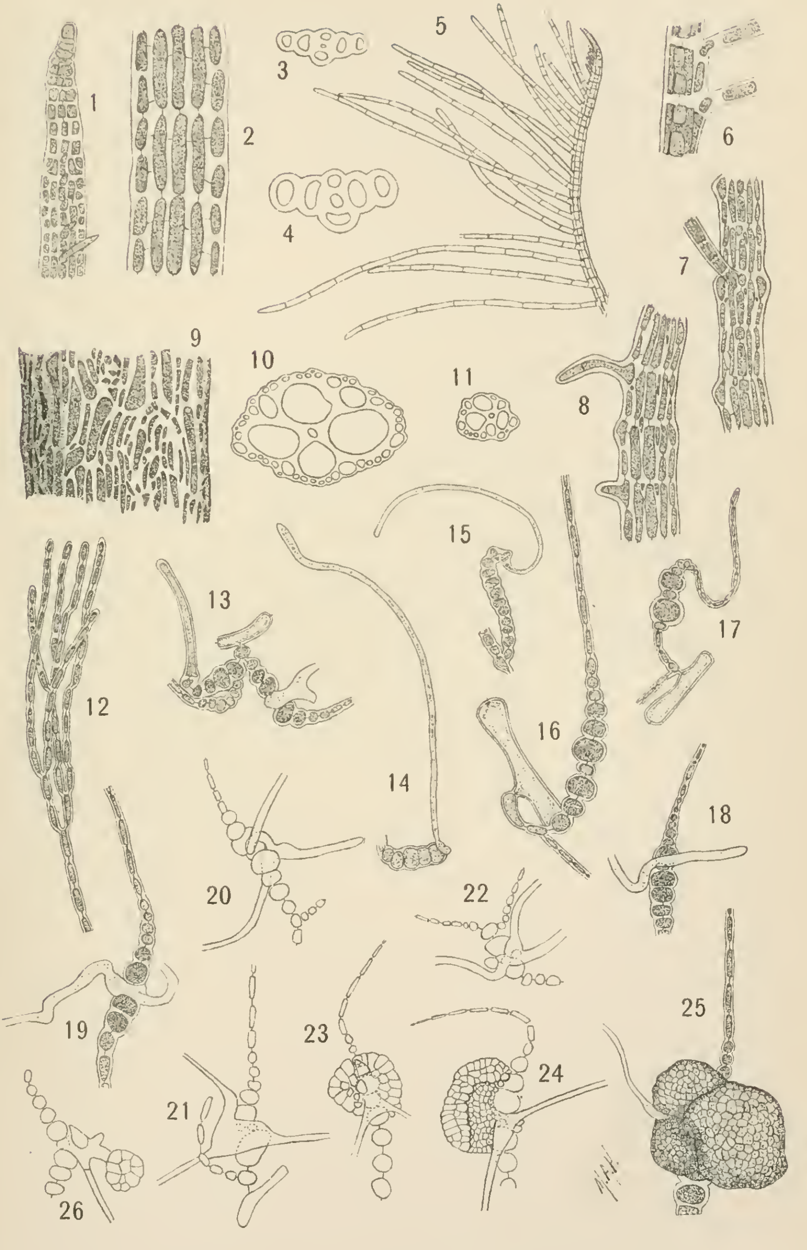
11-20. CLADOCEPHALUS SCOPARIUS M. A. Howe



SARCOMENIA FILAMENTOSA M. A. Howe



DUDRESNAYA CRASSA M. A. Howe.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1-11. SARCOMENIA FILAMENTOSA M. A. Howe

12-26. DUDRESNAYA CRASSA M. A. Howe

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STUDIES ON THE ROCKY MOUNTAIN FLORA—XV

By PER AXEL RYDBERG

NEW YORK
1905

[From the BULLETIN OF THE TORREY BOTANICAL CLUB **32**: 597-610. 1905]

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, 32 : 597-610. 1905]

Studies on the Rocky Mountain flora — XV

PER AXEL RYDBERG

In preparing my Flora of Colorado, to be issued as a Bulletin from the Agricultural College at Fort Collins, Colorado, and now in press, I have found it necessary to change the nomenclature of a number of species. As the scope of the Flora comprises only keys to the families, genera and species, and an enumeration of localities where specimens have been collected, it has been impossible to include therein any fuller synonomy with citations, or any discussions. It has, therefore, seemed advisable to make the publication of these changes and notes elsewhere.

Caryopitys monophylla (Torr. & Frém.) Rydb.

Pinus monophyllus Torr. & Frém. Rep. 319. 1845.

Dr. Small in his Flora of the Southeastern United States has followed the more modern views in dividing genera, which consist of very natural sections or subgenera, into as many separate genera. The genus *Pinus* as usually treated contains at least four distinct subgenera, better defined and more easily distinguished from each other, than for instance *Picea* and *Tsuga*. Three of these had already generic names, *viz.: Pinus* L. (proper), *Apinus* Necker and *Strobus* Opiz. Dr. Small had to give the fourth group, which is wholly American, a new name, *Caryopitys*. In the Rocky Mountain region the genus is represented by the type species *C. edulis* (Engelm.) Small, and by the species given above. One of the four genera is not represented within the area covered by Dr. Small's work, *viz.:*

APINUS Necker, Elem. Bot. 3 : 269. 1790

Most of Necker's genera are hard to determine, but in this case Necker not only gives the characters by which he distinguishes the genus from *Pinus* proper, but also cites two species, *viz.: cembra* and *pinea*. In the Kew Index, the genus is given, but no species are mentioned. The way in which Necker makes his statement, there is all the reason to claim that the two species are there published as *Apinus.* Necker states that *Larix* contains 3 species, *viz.: decidua, cedrus* and *strobus ; Pinus* 2, *sylvestris* and *taeda : Apinus* also 2, *viz.: cembra* and *pinea*, but *Abies* 5, etc. If Necker had meant that these were the Linnaean species of *Pinus* to be distributed among the different genera, he would have stated it differently. There was no *Pinus decidua* L., but a *Pinus Larix* L. and a *Larix decidua* Miller. *Apinus* is most related to *Strobus*, but differs in the thick cone-scales, the erect or horizontal instead of pendent cone and a very hard-shelled seed with only a vestige of a wing. In the Rocky Mountains, it is represented by the two following species :

Apinus flexilis (James) Rydb.

Pinus flexilis James, in Long's Exped. **2** : 34. 1823.

Apinus albicaulis (Engelm.) Rydb.

Pinus albicaulis Engelm. Trans. Acad. St. Louis **2** : 209. 1863.

Sabina utahensis (Engelm.) Rydb.

Juniperus californica utahensis Engelm. Trans. Acad. St. Louis **3** : 588. 1877.

Haller's genus *Sabina* is also one just as consistently taken up by Dr. Small. I shall here give only the Rocky Mountain species to be referred to this genus.

Sabina monosperma (Engelm.) Rydb.

Juniperus occidentalis monosperma Engelm. Trans. Acad. St. Louis **3** : 590. 1877.

Sabina Knightii (A. Nels.) Rydb.

Juniperus Knightii A. Nels. Bot. Gaz. **25** : 198. 1898.

Sabina scopulorum (Sargent) Rydb.

Juniperus scopulorum Sargent, Garden and Forest **10** : 420. 1897.

Sparganium multipedunculatum (Morong) Rydb.

Sparganium simplex multipedunculata Morong, Bull. Torrey Club **15** : 79. 1888.

This is quite distinct from *S. simplex* L. To the characters given by the late Dr. Morong may be added the broad scarious margins of the leaf-sheaths. This character it has in common with *S. americanum* Nutt. of the eastern United States and *S. subvaginatum* Meinsh. of Europe. In fact, Meinshausen included C. C. Parry's plant from Colorado in the latter. It is, however, very doubtful if it belong there, for the original description of *S. subvaginatum* does not fit our plant very well. *S. multipedunculatum* ranges from the Mackenzie River and Washington to Colorado.

Potamogeton Richardsonii (Bennett) Rydb.

Potamogeton perfoliatus lanceolatus Robbins, in A. Gray, Man. ed. 5. 488. 1867. Not *P. perfoliatus lanceolatus* Blytt. 1861.
Potamogeton perfoliatus Richardsonii Bennett, Jour. Bot. **27**: 25. 1889.

Our common North American plant does not seem to intergrade at all with the true *P. perfoliatus* L.

Stipa Porteri Rydb.

Stipa mongolica (Thurber, in A. Gray, Proc. Acad. Phila. **1863**: 79, hyponym. 1863.) Port. & Coult. Syn. Fl. Colo. 145. 1874. Not *S. mongolica* Turcz.

In the enumeration of Hall and Harbour's plants, Thurber determined this plant as *S. mongolica* Turcz., which is evidently erroneous. He gives the name and a short discussion but no description. A good description was afterwards given by Porter and Coulter in the Synopsis of the Flora of Colorado.

Muhlenbergia cuspidata (Torr.) Rydb.

Vilfa cuspidata Torr.; Hook. Fl. Bor. Am. **2**: 238. 1839.
Sporobolus cuspidata Wood, Bot. & Fl. 385. 1870.

The group of grasses, which Torrey, Trinius and Thurber regarded as a good generic type and for which they adopted the name *Vilfa*, is altogether out of place in the genus *Sporobolus*, where its species have been placed by authors. They are no "Drop-seed" grasses at all, the grain remaining enclosed in the firm flowering glume. They should be taken out of *Sporobolus*, but if they should constitute a genus by themselves is questionable. The generic name *Vilfa* is not available, for the type of *Vilfa* Adans. is apparently a species of *Agrostis*. As there is no character, whatever, to separate these plants from *Muhlenbergia* as now limited, the only rational way to treat them at present is to transfer them all to *Muhlenbergia*. At any rate, they are congeneric with *M. Wrightii* Vasey, slender specimens of which are very hard to distinguish from *M. cuspidata* here proposed. The other Rocky Mountain species are:

Muhlenbergia Richardsonis (Trin.) Rydb.

Vilfa Richardsonis Trin. Mem. Acad. St. Petersb. VI. Nat. **5**^{2}: 103. 1840.

? *Agrostis brevifolia* Nutt. Gen. **1**: 44. 1818.

The specific name *brevifolia* may have to be taken up for this species, but it is doubtful if *Agrostis brevifolia* is a synonym of this. Professor Scribner claims that it belongs to the preceding species. What *Vilfa Richardsonis* Trin. is, is not doubtful, and that specific name is therefore preferable.

Muhlenbergia simplex (Scribn.) Rydb.

Sporobolus simplex Scribn. Bull. U. S. Div. Agrost. **11**: 48. 1898.

Muhlenbergia filiformis (Thurber) Rydb.

Vilfa depauperata filiformis Thurb.; S. Wats. Bot. King's Expl. 376. 1871.

Vilfa gracillima Thurb. Bot. Calif. **2**: 268. 1880. Not *Muhlenbergia gracillima* Torr. 1856.

Sporobolus filiformis Rydb. Contr. U. S. Nat. Herb. **3**: 189. 1895.

Muhlenbergia aristulata Rydb.

Sporobolus aristatus Rydb. Bull. Torrey Club **28**: 266. 1901. Not *Muhlenbergia aristata* Pers. 1805.

Muhlenbergia Wolfii (Vasey) Rydb.

Vilfa minima Vasey, Bot. Wheeler Surv. 282. 1878. Not *V. minima* Trin. 1855.

Sporobolus Wolfii Vasey, Bull. Torrey Club **10**: 52. 1883.

Muhlenbergia Thurberi Rydb.

Sporobolus filiculmis Vasey; Beal, Grasses N. Am. **2**: 288. 1896. Not *S. filiculmis* Dewey. 1894.

Vilfa filiculmis Thurber; Beal, *l. c.*, as a synonym.

Both *Sporobolus filiculmis* Vasey and *Vilfa filiculmis* Thurber appeared in 1885 in Vasey's Catalogue of the Grasses of United States, on page 44; but both are there nomina nuda and the first place where a description is published is, as far as I can find, in Beal's Grasses of North America. In the meantime Dewey had published another *Sporobolus filiculmis* which invalidates that specific name.

Sporobolus flexuosus (Thurber) Rydb.

Sporobolus cryptandrus flexuosus Thurber; Vasey, Bot. Wheeler Surv. 282. 1878.

This is evidently specifically distinct from *S. cryptandrus.*

Deschampsia alpicola Rydb. sp. nov.

Deschampsia caespitosa alpina Vasey; Beal, Grasses N. Am. **2**: 368; at least in part. 1896. Not *D. alpina* R. & S. 1817.

Densely cespitose, tufted perennial; sterile shoots numerous; sheaths 2–3 cm. long, glabrous, striate; ligules linear-lanceolate, acuminate, about 5 mm. long; blades 1–2 dm. long, 1–2 mm. wide, stiff, often more or less involute; culm-leaves with sheaths 1–1.5 dm. long and blades 1–4 cm. long; culms 3–5 dm. high; panicle short, open, 8–15 cm. long, its branches in 2's to 5's, 3–6 cm. long, soon spreading; spikelets about 5 mm. long; empty glumes about 4 mm. long, lanceolate, acute; flowering glume nearly as long, hirsute at the base; awn attached one third or one-fourth from the base, one and a half to two times as long as the glume, bent and twisted.

This differs from *D. caespitosa* in the large flowers and the long awns. It has been mistaken for *D. bottnica*, but that species has long narrow inflorescence and comparatively longer empty glumes. *D. alpicola* is rather common in alpine regions of Colorado. A similar if not identical form is also found in Alaska. As the type may be designated:

COLORADO: Mountain meadows, Pike's Peak, Sept. 4, 1901, at an altitude of 3600 meters, *L. M. Underwood XX.*

Graphephorum Shearii (Scribn.) Rydb.

Trisetum argenteum Scribn. Bull. U. S. Div. Agrost. **11**: 49. 1898. Not *T. argenteum* R. & S. 1817.

Trisetum Shearii Scribn. Circ. U. S. Div. Agrost. **30**: 8. 1901.

Professor Scribner has merged *Graphephorum* into *Trisetum*. I think, though, that they should be retained as two distinct genera, even if the former should be transferred to the tribe *Aveneae*.

Distichlis stricta (Torr.) Rydb.

Uniola stricta Torr. Ann. Lyc. N. Y. **1**: 155. 1824.

Distichlis maritima stricta Thurber, Bot. Calif. **2**: 306. 1880.

Distichlis spicata stricta Scribn. Mem. Torrey Club **5**: 51. 1894.

Eatonia robusta (Vasey) Rydb.

Eatonia obtusata robusta Vasey; Beal, Grasses N. Am. **2**: 493. 1896.

To the characters given in the original description should be added: intermediate nerves of the second glume very strong, and leaf-blades firm, much broader than the sheaths, and therefore forming distinct auricles at the base. The nerves mentioned are in this species almost as prominent as the lateral nerves. In *E. obtusata* they are faint, while the lateral ones are very prominent.

Eatonia intermedia Rydb. sp. nov.

Culm 6–8 dm. high, 1.5–2.5 mm. thick, striate, shining; sheaths 5–15 cm. long, striate, minutely scabrous; ligules about 2 mm. long, truncate, erose and often cleft; blades 8–15 cm. long, 3–5 mm. wide, usually flat, broader than the sheaths and therefore forming distinct auricles at the base; inflorescence rather narrow and dense, 8–15 cm. long, 1–3 cm. wide; spikelet usually 2-flowered; first empty glume about 2 mm. long, subulate, scabrous on the back; second empty glume oblanceolate in side view, rather firm, slightly scarious on the margin, with prominent scabrous nerves, obtusish, about as wide as the flowering glumes, a little over 2 mm. long and 0.5 mm. wide; flowering glume oblong-lanceolate in side-view, rather firm, with faint nerves and minutely scabrous; palate narrowly linear, scarious.

This species has been named both *E. obtusata* and *E. pennsylvanica*, and is intermediate between the two. From the former it differs in the narrower second glume, which is scarcely broader than the flowering glume and neither truncate nor cucullate at the apex; from *E. pennsylvanica* it differs in the denser inflorescence and the firmer and less acute second glume, which has the texture of that of *E. obtusata.* In *E. pennsylvanica* the second empty glume is thin, very acute and with a broad scarious margin.

A few of the specimens to be referred to this are given here:

MONTANA: East Gallatin Swamps, July 24, 1896, *P. A. Rydberg 3174* (type) and *3173;* Columbia Falls, 1893, *R. S. Williams;* Blue Cloud, near Helena, 1887, *F. D. Kelsey.*

COLORADO: Gunnison, 1901, *C. F. Baker 524;* Pagosa Springs, 1899, *Baker 169;* Durango, 1898, *Baker, Earle & Tracy 950* (the last determined as *Agrostis exarata*).

Poa callichroa Rydb. sp. nov.

Perennial with a horizontal rootstock, but more or less matted; culm about 3 dm. high, mostly leafy at the base; sheaths strongly striate, 2–10 cm. long; ligules lanceolate or ovate, acute, about 3 mm. long; blades of the lower leaves 6–10 cm. long, 3–4 mm. wide, firm, dark-green, strongly veined; blades of the upper leaves about 3 cm. long, erect; panicle 6–9 cm. long, open; branches mostly in 3's or 4's below, the lowermost 2–3 cm. long; spikelets 6–8 mm. long, 5–7-flowered; empty glumes lanceolate in side-view, about 5 mm. long, acuminate, purple with greenish or brownish margins; flowering glumes 4–5 mm. long, lanceolate, acuminate, with strong nerves, green below, then purple, then brown, and white and scarious above; nerves and internerves more or less villous; cobweb at the base present but scant.

This species is a relative of *P. arctica* and *P. cenisia*, but differs from both in the taller habit, broader leaves and larger, 5–7-flowered (instead of 3–4-flowered) spikelets.

COLORADO: Dead Lake, near Pike's Peak, August 14, 1901, *F. E. & E. S. Clements 457.*

Poa pudica Rydb. sp. nov.

Perennial with a short rootstock and often tufted; culm 2–3 dm. high; lower leaves with short sheaths, which are often rather loose; ligules truncate, about 2 mm. long; blades 4–5 cm. long, usually conduplicate, strongly nerved; sheaths of the stem-leaves 5–7 cm. long; blades 2–4 cm. long, erect; panicle 4–8 cm. long, open; branches usually in pairs, in age reflexed; the lowest 4–5 cm. long, bearing the spikelets near the ends; spikelets 4–5 mm. long, mostly 3-flowered; empty glumes lanceolate in side view, strongly veined, usually purple, acuminate; flowering glumes lanceolate, sharp-acuminate, greenish below, then purplish and scarious at the apex; cobweb present but scant; internerves glabrous and nerves pubescent.

The type specimens were determined by Professor Scribner as *P. arctica*, but it differs from that species in the smaller more sharply acuminate flowering glumes and their glabrous internerves. These characters would place it closer to *P. reflexa.* The latter species is, however, taller, and the intermediate nerves of the flowering glumes are glabrous.

COLORADO: Stephen's Mine, below Gray's Peak, Aug. 23, 1895, *P. A. Rydberg 2443* (type); near Pagosa Peak, Aug. 1899, *C. F. Baker 209* (determined as *P. reflexa*); high mountains about Empire, 1892, *H. N. Patterson 272.*

Poa macroclada Rydb. sp. nov.

Perennial with a horizontal rootstock; culm 6–8 dm. high; sheaths 5–15 cm. long, rather loose, strongly striate, slightly scabrous; ligules ovate, acute, about 2 mm. long; leaf-blades 7–10 cm. long, 2 mm. or less wide, flat, glabrous, firm and dark-green; panicle 2–3 dm. long, open; branches in 3's–5's, in fruit reflexed or spreading, the lower often 1 dm. long, with the spikelets near the ends; spikelets often about 5 mm. long, 2- or 3-flowered; empty glumes lanceolate, very acute, more or less purplish; flowering glume lanceolate, acute or acuminate, glabrous, slightly purple-tinged; intermediate veins faint and cobweb scant.

This species is related to *P. aperta*, but differs in the long slender branches of the panicle and the glabrous flowering glumes.

COLORADO: Roger's, Gunnison Watershed, August 14, 1901, *C. F. Baker 802.*

Poa interior Rydb. sp. nov.

Poa nemoralis Scribn. Bull. U. S. Div. Agrost. **17**: 250. 1899. Not *P. nemoralis* L. 1753.

? *Poa caesia* Coult. Man. Rocky Mt. Reg. 421. 1885. Not *P. caesia* Smith. 1800.

The grass common throughout the Rocky Mountain region and extending in the north from Alaska to the Dakotas and generally known as *P. nemoralis* is quite different from the European plant. The latter is found in America as sparingly introduced in the Eastern States. The European plant is taller, with soft, flaccid leaves, ovate or lanceolate acute ligules, larger spikelets and narrowly lanceolate empty glumes which are tapering gradually at the apex and much narrower than the flowering glumes. The American plant is usually lower and stiffer, has rather firm leaves, truncate ligules, smaller spikelets, broader empty glumes, which are rather abruptly acuminate and at least the second almost as broad as the flowering glumes. The name *P. nemoralis* was used for the American plant by Hooker and Arnott,* but appears there without a description. It was adopted by several authors on western botany; but, as far as I know, never described under that name, until 1899 by Professor Scribner. His description and plate illustrates the American rather than the European plant. As the type may be designated:

Wyoming: Headwaters of Clear Creek and Crazy Woman River, 1900, *Frank Tweedy 3706.*

Poa phoenicea Rydb. sp. nov.

Perennial with a horizontal rootstock and extravaginal innovations; culm 5–6 dm. high, leafy; sheaths loose, 5–15 cm. long, striate; ligules triangular-lanceolate or ovate, acute, about 5 mm. long; blades 1–2 dm. long, about 2 mm. wide, rather firm, strongly veined; panicle 6–10 cm. long, open, its branches mostly in pairs, the lower 5–6 cm. long; spikelets 4–5-flowered, 6–7 mm. long; empty glumes lanceolate, acuminate, purple or green below and purple above, glabrous and shining; flowering glumes lanceolate, green at the base, purple in the middle and brownish-scarious at the top; both nerves and internerves villous; cobweb none; intermediate nerves very faint.

This species resembles somewhat *P. pseudo-pratensis*, *P. epilis* and *P. purpurascens* Vasey (see below). From the first it differs by the more acuminate glumes, the faint intermediate nerves of the flowering glumes and the longer, narrower leaves; from the other two by the open inflorescence, the villous, not scabrous flowering glumes and the creeping rootstock.

Colorado: Pike's Peak Valley, Aug. 21, 1901, *F. E. & E. S. Clements 466.*

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* Bot. Beech. Voy. 132. 1832.

Poa subpurpurea Rydb. nom. nov.

Poa purpurascens Vasey, Bot. Gaz. 6: 297. 1881. Not *P. purpurascens* Sprengel. 1819.

Poa tricholepis Rydb. sp. nov.

Perennial with a creeping rootstock and extravaginal innovations; sheaths of the basal leaves short, 2–4 cm. long, strongly striate, rather loose, minutely retrorse-striate; blades 5–10 cm. long, a little over 1 mm. wide, scabrous; sheaths of culm-leaves 7–12 cm. long; blades 2–6 cm. long, sometimes nearly 2 mm. wide; ligules lanceolate, acuminate, about 4 mm. long; culm slender, 3–5 dm. high; panicle 6–8 cm. long, open, its branches in pairs, 2–3 cm. long; spikelets 3–4-flowered, 5–8 mm. long; empty glumes about 4 mm. long, lanceolate in side view, acute, green and purple towards the apex; flowering glumes about 4 mm. long, villous below, strigose above, green, bordered with purple and a scarious border, obtuse.

This is related to *P. Wheeleri* and *P. Vaseyana*, but is easily distinguished from both by the obtuse flowering glume, which is villous below. In the two species mentioned the flowering glume is very acute and strigulose or scabrous throughout, or in *P. Vaseyana* hairy on the nerves only.

COLORADO: Near Pagosa Peak, Aug. 1899, *C. F. Baker 210.*

Poa nematophylla Rydb. sp. nov.

A cespitose bunch-grass; basal leaf-blades short, striate, minutely retrosely strigulose; stipules lanceolate, acuminate, about 3 mm. long; blades 1–1.5 dm. long, filiform, strongly involute, less than 0.5 mm. wide, scabrous-strigulose; culm-leaves few, near the base; sheaths 4–6 cm. long; blades 3–5 cm. long; culm about 3 dm. high, filiform; inflorescence narrow, raceme-like, 2–5 cm. long; branches 2–10 mm. long, bearing often only a single spikelet; spikelets 7–9 mm. long, about 4-flowered; empty glumes about 4 mm. long, lanceolate, glabrous and shining; flowering glumes about 6 mm. long, light-green, with a silvery scarious margin, very acute, strigose below, scabrous-strigulose above.

Related to *Poa idahoensis*, but distinguished by the narrow inflorescence and few racemosely disposed spikelets.

COLORADO: Meeker, Rio Blanco County, June 8, 1902, *G. E. Osterhout 2601.*

Poa confusa Rydb. sp. nov.

A tufted bunch-grass with intravaginal innovations; sheaths of the basal leaves short, striate, glabrous; blades 1–2 dm. long, 2–3 mm. wide, flat or involute, puberulent; culm-leaves several; sheaths 1–1.5 dm. long; blades about 1 dm. long; ligules broadly ovate or rounded, obtuse or acutish, about 2 mm. long; culm 6–9 dm. high; panicle narrow, 1–1.5 dm. long, dense; branches short, strongly ascending; spikelets 7–8 mm. long, usually 4-flowered; empty glumes lanceolate in side-view, shining, minutely strigulose above; flowering glumes narrow, about 3.5 mm. long, obtuse or rounded at the apex, rounded on the back below, strigulose, yellowish-green with brownish scarious margin.

This species has been confused with *P. laevigata*, *P. lucida* and *P. nevadensis*. It differs from the first two by the short and broad ligules (in both the ligules are lanceolate and acuminate), and from the last by the empty glumes and in being scarcely scabrous. In *P. nevadensis* the empty glumes are strongly nerved, elongated-lanceolate, almost equaling the oblong, very scabrous flowering glumes; in *P. confusa* they are faintly nerved, broadly lanceolate, shorter than the flowering glumes. *P. confusa* grows in open "parks" and on hills from Nebraska and Montana to Colorado. As the type may be assigned:

WYOMING: Medicine Bow Mountains, Albany County, July 28, 1900, *Aven Nelson 7787*.

Poa truncata Rydb. sp. nov.

A species related to the preceding but stiffer; basal leaves withering early; sheaths of culm-leaves 10–15 cm. long, with conspicuous hard auricles at the mouth; ligules very short, about 1 mm. long, truncate; blades 1–2 dm. long, 2–3.5 mm. wide, scabrous on the back; culm about 9 dm. high, stiff; panicle about 1.5 dm. long, narrow, with almost erect scabrous branches; spikelets 3–5-flowered, 7–9 mm. long; empty glumes 5–6 mm. long, tinged with purple, scabrous on the nerves; flowering glumes narrow, about 5 mm. long, straw-colored or tinged with purple, strigulose throughout and slightly scabrous on the veins.

The short truncate ligules separate this from the preceding and all other related species.

COLORADO: Dillon, Summit County, August 26, 1896, *F. E. Clements 373*.

Festuca Earlei Rydb. sp. nov.

Perennial with rootstocks and extravaginal innovations; basal leaves with short ligules; blades filiform, 5–10 cm. long, strongly involute, 0.5 mm. wide or less; sheaths of the culm-leaves 3–5 cm. long, striate, smooth; ligules very short, truncate; blades 3–5 cm. long, 1 mm. wide or less; culm about 3 dm. high, very slender; panicle narrow and spike-like, 3–5 cm. long; branches short and erect, smooth; spikelets 2–3-flowered, about 5 mm. long; first empty glume about 2 mm. long, narrowly lanceolate; the second about 3 mm. long, ovate-lanceolate, 3-nerved; flowering glumes narrowly lanceolate, about 4 mm. long, smooth, usually awned; awn 1 mm. or less long.

This species is related to *F. rubra*, but differs in the smaller few-flowered spikelets, the smaller flowering glumes, and the fine, soft leaves.

COLORADO: La Plata Cañon, July 11, 1898, *Baker, Earle & Tracy 920.*

Festuca ingrata (Hack.) Rydb.

Festuca ovina ingrata Hack.; Beal, Grasses N. Am. **2**: 598. 1896.

This is the common plant of the Rocky Mountain region, which has been known under the name *F. ovina*. It is quite different from the European *F. ovina* L. The latter is found in America only in the northeastern part of the continent.

Festuca minutiflora Rydb. sp. nov.

Tufted perennial with intravaginal innovations; leaves mostly basal; sheaths smooth, 1 cm. or so long; ligules 0.75 mm. long, obtuse or rounded at the apex; blades 5–10 cm. long, narrow and flaccid, about 0.5 mm. wide; sheaths of the culm-leaves 2–4 cm. long; blades 1–3 cm. long; culm very slender, 1–1.5 (seldom 3) dm. high; panicle very narrow, lax, 2–4 cm. long, with very short erect branches; spikelets, excluding the awns, about 5 mm. long, 2–3-flowered; first empty glume narrowly lanceolate, 2–2.5 mm. long, acute; the second 2.5–3 mm. long, ovate-lanceolate, short-acuminate or awn-pointed; flowering glume oblong-lanceolate, about 2 mm. long, purple-tinged above, abruptly contracted into a short awn, 1.5 mm. or less.

This is closely related to *F. brachyphylla*, but differs in the smaller spikelets, the more abruptly acuminate flowering glumes, the shorter awns, the laxer panicle and the soft filiform leaves. It grows in alpine situations of Colorado, at an altitude of 3000–4000 meters, and is found apparently also in California.

COLORADO: Cameron Pass, July 13, 1869, *C. F. Baker* (type); near Pagosa Peak, 1899, *Baker 176*; "Colorado," *E. Hall 12*; Mt. Lincoln, *John Wolf*; Tennessee Pass, 1893, *De Alton Saunders*; Mt. Ouray, 1896, *F. E. Clements 210½*; near Manitou, 1896, *Clements 46*.

CALIFORNIA: *Bolander 5066*.

Elymus strigosus Rydb. sp. nov.

A cespitose perennial; sheaths 3–8 cm. long, striate, glabrous or minutely puberulent, with distinct auricles at the mouth; ligules very short, truncate, 1 mm. long or less; blades 1–2 dm. long, about 3 mm. wide, flat or involute, scabrous; culm 5–7 dm. high; spike 1–1.5 dm. long; spikelets 1 or 2 at each node; empty glumes linear-subulate, 7–9 mm. long, very scabrous; flowering glumes lanceolate, scabrous-strigose, awn-pointed or short-awned, without the awn about 1 cm. long.

This is closely related to *E. ambiguus*, but distinguished by the scabrous strigose flowering glumes, the more scabrous empty glumes and the narrower leaves.

COLORADO: Near Boulder, at an altitude of 2300 meters, July 31, 1886, *C. W. Letterman 553* (type, labeled *Agropyrum dasystachyum*).

WYOMING: Naked shale slopes, Point of Rocks, Sweetwater County, 1900, *Aven Nelson 7151* (labeled *Elymus salinus*).

Elymus villiflorus Rydb. sp. nov.

A cespitose perennial; sheaths 4–10 cm. long, striate, glabrous; blades 1–2 dm. long, about 2 mm. wide, strongly involute, scabrous above; culm 4–6 dm. high, finely retrorse-pubescent above; spike 1–1.5 dm. long; spikelets 1 or 2 at each node; empty glumes subulate, 7–9 mm. long; flowering glumes lanceolate, 5-nerved, villous-hirsute, without the short awn about 1 cm. long.

Closely related to the preceding and *E. ambiguus*, this is characterized by its long-haired and more strongly nerved flowering glume. It grows on plains and foothills at an altitude of 1500–1800 meters.

COLORADO: Near Boulder, July, 1902, *F. Tweedy 4818* (type).
ALBERTA: Banff, July 21, 1900, *H. B. Lawson.*

Juncoides intermedium (Thuill.) Rydb.

Juncus intermedius Thuill. Fl. Env. Paris. ed. 2. 178. 1799.
Juncus multiflorus Ehrh.; Hoffm. Fl. Deutschl. ed. 2. **1**: 169. 1800. Not *J. multiflorus* Retz. 1795.

This is the plant that has been known in America under the name *Luzula campestris* or *Juncoides campestre*, but this North European species is found, if at all on this continent, only in the extreme northeastern portion. It is distinguished from *J. intermedium* by its fewer, larger and nodding spikelets. The name *Juncus multiflorus* dates back as far as 1791, when Ehrhart issued his set of grasses, sedges, etc., but as far as can be ascertained, it was never published for this plant before 1800, in the revised edition of Hoffmann's Flora.

Nemexia lasioneuron (Hook.) Rydb.

Smilax lasioneuron Hook. Fl. Bor. Am. **2**: 173. 1838.
Nemexia herbacea melica Aven Nelson, Proc. Biol. Soc. Wash. **17**: 175. 1904.

Ibidium porrifolium (Lindl.) Rydb.

Spiranthes porrifolia Lindl. Gen. & Sp. Orch. 467. 1840.

Mr. House* has shown that *Ibidium* Salisb. is the name that properly should be used for *Spiranthes* Richard and *Gyrostachys* (Pers.) Kuntze; *Ophrys* L. for *Listera* R. Br. and *Cytherea* Salisb. for *Calypso* Salisb. The Rocky Mountain species of these genera, which have not already been transferred, are given here.

Ophrys borealis (Morong) Rydb.

Listera borealis Morong, Bull. Torrey Club **20**: 31. 1893.

Ophrys nephrophylla Rydb.

Listera nephrophylla Rydb. Mem. N. Y. Bot. Gard. **1**: 108. 1900.

Ophrys caurina (Piper) Rydb.

Listera caurina Piper, Erythea **6**: 32. 1898.

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*Bull. Torrey Club **32**: 378–382. 1905.

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THE POLYPORACEAE OF NORTH AMERICA—XIII

THE DESCRIBED SPECIES OF BJERKANDERA, TRAMETES, AND CORIOLUS

By WILLIAM ALPHONSO MURRILL

NEW YORK
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[From the BULLETIN OF THE TORREY BOTANICAL CLUB **32**: 633-656. 1906]

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The Polyporaceae of North America — XIII. The described species of Bjerkandera, Trametes, and Coriolus

WILLIAM ALPHONSO MURRILL

In article XII of this series the above genera were listed and described in their proper order, but the species were omitted for lack of space. The present paper deals with the published species only of these three genera.

BJERKANDERA Karst. Medd. Soc. Faun. et Fl. Fenn. 5 : 38. 1879

Merisma Gill. Champ. Fr. **1** : 688. 1878. Not *Merisma* Persoon.

Myriadoporus Peck, Bull. Torrey Club **11** : 27. 1884.

This genus was based on *Bjerkandera adusta* (Fr.) and six other species, and described as follows:

> "Receptaculum pileatum, sessile, carnoso-lentum, molle, elasticum, anodermeum. Pileus azonus. Hymenium heterogeneum. Pori colorati, integri."

Merisma of Gillet was based on *Merisma imberbe* (Bull.) and twelve other species. The name had been previously used by different authors for groups of fungi in which the sporophore was branched. Persoon used it for a group of the *Clavariaceae*.

Myriadoporus of Peck was founded upon *Myriadoporus adustus* Peck, which is only an abnormal form of *Bjerkandera adusta* (Willd.) Karst., and hence a synonym.

Synopsis of the North American species

1. Hymenium smoke-colored when very young, becoming black with age. 1. *B. adusta.*

Hymenium pallid when very young, becoming more or less smoke-colored with age. 2.

2. Tubes round, equal and rather thick-walled at maturity, becoming lacerate only with age; plant not fragrant. 2. *B. fumosa.*
Tubes angular, unequal and thin-walled at maturity; plant fragrant. 3. *B. fragrans.*

1. BJERKANDERA ADUSTA (Willd.) Karst.

Boletus adustus Willd. Fl. Berol. 392. 1787.
Boletus fuscoporus Plan. Pl. Erf. 26. 1788.
Boletus suberosus Batsch, Elench. Fung. *pl. 226.* 1789.
Boletus pelleporus Bull. Herb. Fr. **11**: *pl. 501. f. 2.* 1790.
Boletus carpineus Sowerby, Eng. Fung. *pl. 231.* 1799.
Boletus adustus crispus Pers. Obs. Myc. **2**: 8. 1799.
Polyporus crispus Fr. Obs. Myc. **1**: 127. 1815.
Boletus isabellinus Schw. Syn. Fung. Car. 70. 1818.
Polyporus adustus Fr. Syst. Myc. **1**: 363. 1821.
Polyporus subcinereus Berk. Ann. Mag. Nat. Hist. **3**: 391. 1839.
Polyporus Halesiae B. & C. Ann. Mag. Nat. Hist. II. **12**: 434. 1853. — Grevillea **1**: 52. 1872.
Bjerkandera adusta Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 38. 1879.
Myriadoporus adustus Peck, Bull. Torrey Club **11**: 27. 1884.
Polyporus Burtii Peck, Bull. Torrey Club **24**: 146. 1897.

The history of this fungus has been that of most of our abundant, widespread and variable species: it has been named and renamed again and again in various countries by mycologists not in touch with each other and not conversant with the work already done, until, with types gone and data lost, it seems wellnigh impossible to follow the various specific and varietal names with exactness. The above list, however, while not complete, represents fairly well the best known synonyms since Willdenow first described it in 1787.

Four or more new names have been given the plant in this country from the days of Schweinitz to the present time. Berkeley's name, *P. subcinereus*, assigned to plants collected at Carlton House by Richardson, was corrected by Montagne and the correction accepted by Berkeley. *P. Halesiae*, described from plants collected by Ravenel on *Halesia tetraptera* in Georgia, is acknowledged by the authors to be allied to *P. crispus*, but claimed to be distinct. *P. crispus* itself was without sufficient reason raised to specific rank from the varietal distinction accorded it by Persoon. In describing *P. Burtii* from plants collected on birch in Vermont, Peck says "This fungus is closely allied to *Polyporus adustus*, of which it might easily be considered a mere variety."

The pallid pileus and small-pored, dark hymenium, which looks as though it had been too near to a forest fire, are well known to most collectors. In its resupinate forms it is not easily distinguished from *P. dichrous* and from *Gloeoporus conchoides*. The spores are smooth, hyaline, ellipsoid-allantoid, $3–5 \times 1.5–2.5\ \mu$. Specimens are abundant on all kinds of dead deciduous wood and only representative ones will be listed here in order to show the wide range of the species:

Germany, *Magnus*; Hungary, *Dietz*; Sweden, *Murrill*; England, *Murrill*; Canada, *Macoun*; Maine, *Miss White, Ricker, Murrill*; Connecticut, *Miss White*; New York, *Burnham, Earle*; New Jersey, *Ellis, Murrill*; Delaware, *Commons*; Pennsylvania, *Banker, Sumstine*; Virginia, *Murrill*; North Carolina, *Memminger*; Georgia, *Harper*; Tennessee, *Murrill*; Florida, *Lloyd*; Alabama, *Earle*; Louisiana, *Langlois*; Ohio, *Morgan*; Missouri, *Glatfelter*; Kansas, *Bartholomew*; Oregon, *Carpenter*.

2. BJERKANDERA FUMOSA (Pers.) Karst.

Boletus fumosus Pers. Syn. 530. 1801.
Polyporus fumosus Fr. Obs. Myc. **2**: 257. 1818.
Bjerkandera fumosa Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 38. 1879.

This species appears to be fairly common throughout temperate regions on various forms of deciduous wood. Those who consider *Boletus imberbis* Bull., *Polyporus holmiensis* Fr. and *Polyporus salignus* Fr. forms of this species would undoubtedly include *Polyporus fragrans* Peck in the same category. The typical plant has round regular pores, more or less smoky, especially when bruised, and usually splitting with age. Among the numerous foreign and American specimens, the following may be mentioned:

Austria, *Bresadola*; Scotland, *Berkeley*; England, *Plowright*; Canada, *Macoun, Dearness*; New York, *Shear*; New Jersey, *Murrill*; Pennsylvania, *Everhart, Sumstine*; Delaware, *Commons*; Virginia, *Murrill*; Ohio, *Morgan*; Kansas, *Bartholomew*; Missouri, *Demetrio;* Iowa, *Holway;* Nebraska, *Webber;* Montana, *Anderson.*

3. **Bjerkandera fragrans** (Peck)

Polyporus fragrans Peck, Rep. N. Y. State Mus. **30**: 45. 1878.

Described from specimens collected on decaying trunks of elm trees near Bethlehem, New York, in October. The following note is appended to the description: "This species is closely related to *P. adustus* and *P. fumosus*, from which it is readily separated by the unequal pores. Its odor when fresh is very decided and quite agreeable, being not much unlike that of dry Seneca grass."

In a later report Peck says: "After heavy rains this fungus has a moist brownish appearance tinged slightly with dull red, and is obscurely zonate. It is paler when dry and sometimes slightly spotted. It is very closely allied to *P. fumosus*, and perhaps ought to be considered a mere variety of it. It is distinguished by its agreeable odor and by the thinner and sometimes lacerated dissepiments of its more unequal and angular pores."

Since Peck first described it, specimens have been collected on several other deciduous hosts beside elm and in many other states beside New York and Vermont, as the following will show: Canada, *Macoun*, *Dearness;* Vermont, *Morgan*, *Brainerd;* New York, *Peck*, *Cook*, *Miss Overacker;* New Jersey, *Cardiff;* Kansas, *Swingle*, *Cragin*, *Bartholomew;* Missouri, *Demetrio;* Wisconsin, *Baker;* Nebraska, *Webber;* Michigan, *Langdon.*

SPECIES INQUIRENDAE

POLYPORUS TEREBRANS B. & C. Jour. Linn. Soc. Bot. **10**: 306. 1868. Collected by Wright on dead trees in Cuba and thus described:

> "Pileo subcarnoso, crasso, convexo, flabelliformi, luteo, pubescenti-scabro; stipite crasso lateraliter compresso, matrici pro magna parte, immerso, pubescente; pileo concolore; hymenio convexo, albido; poris parvis, acie obtusis.
>
> "Pileus 1½ inch long, 1¾ wide; stem ¾ inch long and thick; pores $\frac{1}{84}$ inch across, probably much contracted."

Only one poor specimen is to be found at Kew, which resembles *Piptoporus suberosus* in general form. The stipe appears abnormal as though the result of an effort on the part of the sporophore to escape from the substratum. The hymenium is now quite dark in color.

POLYPORUS ALBOSTYGIUS B. & C. Jour. Linn. Soc. Bot. **10**: 309. 1868. Described from plants collected by Wright on dead wood in Cuba as follows:

> "Pileo e resupinato breviter reflexo tomentoso pallido, margine pulvinato; hymenio nigro; poris minimis punctiformibus intus contextuque albis."
>
> "Pileus with pores 2 lines thick; pores 1/180 inch in diameter, angular under a high magnifier. A very curious species."

The type specimens at Kew are white above and within, while the mouths of the tubes are very black. The name is well chosen.

TRAMETES Fr. Gen. Hym. 11. 1836

This genus was established upon *Polyporus suaveolens* and its allies, constituting one group, and *Daedalea gibbosa, D. elegans, D. rubescens*, etc., constituting a second subdivision. *Polyporus suaveolens* is the type. The genus is characterized by Fries as follows:

> "Hymenophorum omnino immutatum et cum pilei substantia concolor inter poros descendit. Pori rotundati aut lineares, acie crassa et obtusa distincti, simplices, integerrimi, numquam laceri. Pileus suberosus."

Synopsis of the North American species

Pores small, round, thick-walled; plant white, very fragrant, only slightly yellowish on drying. 1. *T. odora.*
Pores much larger, 5 to 10 to a cm., angular, thin-walled; plant not fragrant, deep fawn-colored when dry. 2. *T. unicolor.*

1. TRAMETES ODORA (Sommerf.) Fr.

Polyporus odorus Sommerf. Suppl. Fl. Lap. 275. 1826. — Fr. Elench. Fung. 90. 1828.
Trametes odora Fr. Epicr. 491. 1838.
Daedalea puberula B. & C. Grevillea **1**: 67. 1872.

This species was first described from Lapland as follows:

> "Dimidiatus irregularisque, pileo glabro pallescente, poris rotundis albido-ochraceis. *Boletus* L. Fl. Lap. no. 522. In Salicibus Nordlandiae saltensis."
>
> "Odore pergrato et forti aniseo memorabilis. Interstitia pororum lacerata apparebant, pori tamen integri rotundi."

The circumstances under which this species was established are not satisfactory. The author had young, poorly developed specimens, and he acknowledges that Linnaeus' plant, *B. suaveolens,* was unknown to him, hence he, as well as Linnaeus, may have confounded the two species. However, specimens sent by him to Fries were considered distinct and his name was taken up as a varietal name under *P. suaveolens* in the Elenchus. Other contemporary botanists seem to have concurred in this view of the matter.

The species is certainly very near to *P. suaveolens* and was considered the same by Linnaeus. It has been reported only on willow from the northern parts of Europe and Asia. On comparing North American plants collected on willow with specimens at Kew and other foreign herbaria, it appears that they are all *T. odora*, differing from the Southern European species in being at first pubescent and at length smooth, with minor differences in context and pores. From what we know of distribution in the northern hemisphere, we should expect to find the more northerly species continuous around the globe.

Very few specimens are to be found in the herbarium here, although the plant is certainly not rare on willow in this country and its appearance is well known to most collectors. The following specimens are at hand: Maine, *Harvey;* New Hampshire, *Wilson;* Vermont, *Burt;* New York, *Underwood*, *Shear*, *Banker*, *Peck;* New Jersey, *Ellis;* Pennsylvania, *Gentry*. Accompanying the specimens collected recently by Banker was the following excellent field diagnosis:

"Odor of anise. First growing from the side of standing and then from fallen dead willow. In each case hymenium horizontal. Plant dimidiate, sessile, spreading to some extent beneath the prostrate log. Whitish throughout, becoming gray with age. Upper surface pubescent. Substance solid, tough, subwatery, elastic, resembling somewhat *Piptoporus suberosus;* stratified, the new growth continuous from the upper side of pileus around margin and over the hymenium. In old specimens these layers can be peeled off as in an onion."

2. **Trametes unicolor** (Schw.)

Boletus unicolor Schw. Syn. Fung. Car. 71. 1818.
Polyporus unicolor Fr. Epicr. 458. 1838.
Polyporus obtusus Berk. Ann. Mag. Nat. Hist. **3**: 390. 1839.

This species was collected in quantity on the trunks of living trees in North Carolina and described by Schweinitz very fully. According to him it is always to be found about half way up the trunk. I have found it in this position quite frequently on the trunks of shade trees in Washington, D. C.

Berkeley's description was taken from specimens in the Hooker herbarium collected in North America by Drummond and labeled *P. Drummondii* by Klotzsch. Comparison of the type specimens at Kew and Philadelphia shows the two species *P. unicolor* and *P. obtusus* to be synonymous. Either name is a very suitable one.

This is a large and conspicuous plant, but rather hard to collect on account of its arboreal habit. It has been found on dead or partly decaying living trunks of oak, maple and a few other deciduous trees. The pileus is quite soft and elastic when young and the tubes are very long and become somewhat daedaleoid by confluence as they grow older. Although abundant and well known in some localities, the species has not been often reported: New Jersey, *Ellis*, *Meschutt;* Maryland, *Maxon;* District of Columbia, *Murrill;* Virginia, *Murrill;* North Carolina, *Schweinitz;* Missouri, *Demetrio;* Iowa, *Holway;* Wisconsin, *Baker.*

SPECIES INQUIRENDAE

SISTOTREMA SPONGIOSUM Schw. Syn. Fung. Car. 75. 1818. *Polyporus labyrinthicus* Fr. Elench. Fung. 83. 1828. Described from North Carolina plants collected on living or recently fallen trunks. Discussed at some length by Fries, who received specimens from Schweinitz. In their commentary, Berkeley and Curtis say it is remarkable for its coarse, tow-like texture, but they do not associate it with any better known name or species.

There are many reasons for believing this species to be a near ally of *P. unicolor.* All the descriptions point to an old specimen of this latter plant in which the tubes have become quite daedaleoid and the dissepiments broken up. A sheet of specimens at Kew labeled *P. labyrinthicus* from Plowright's herbarium shows well the characters of *P. unicolor.* They may not be authentic, however, though they seem old enough to be so considered. On the same sheet at the bottom are the specimens of *P. leucospongia* sent from Harkness with their original label, *P. labyrinthicus*, just as he sent them. These are the cause of the confusion of the two species, as we see it in Saccardo's Sylloge, for example.

POLYPORUS TOMENTOSO-QUERCINUS Johnson, Bull. Minn. Acad. Nat. Sci. **1**: 338. 1878. Described from the author's collections in Minnesota as follows:

> "Pileus at first soft, compact, spongy, tomentose, pulvinate, dimidiate, sessile, very thick, divergently fibrous within, broad surface of attachment, dirty grayish white when young, pale straw or subferruginous when old, hard, coriaceous, woody at maturity; pores large, irregular, toothed or fringed, easily separated, from ¾ to 1 inch long, varying in color from straw to bright orange."
>
> "Nearly always on the north side of living oaks. Pileus 1 to 2 inches thick, 2 to 5 inches broad. Spores numerous, white, globose, very small. Drops its spores in May or early June. Plant is persistent, lasting the whole year. * * * Very scarce, only seen occasionally."

The above description applies very well to the western form of *Trametes unicolor*. It is necessary, however, to see the type plants before definitely connecting the two forms.

CORIOLUS Quél. Ench. Fung. 175. 1886

Hansenia Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 39. 1879. Not *Hansenia* Turcz. 1844.

The genus *Hansenia* was founded upon *Hansenia hirsuta* (Wulf), with seventeen additional species, and thus described:

> "Receptaculum pileatum, dimidiatum, sessile, primitus aridum et firmum. Pileus cuticula tenui, fibrosa, coriaceus, villosus, zonatus, contextu floccoso, tenaci. Hymenium homogeneum. Pori trama pilei distincti ejusque substantiae verticaliter oppositi, subrotundi."

Unfortunately, the name *Hansenia* had been proposed by Turczaninow as early as 1844 (Bull. Soc. Nat. Mosc. **17**: 754) for a genus of the *Umbelliferae* and is consequently ineligible, leaving the vacancy to be filled by *Coriolus* of Quélet, founded upon *Polyporus zonatus* Fr. and seven other species, with the following description:

> "Pileus villosus, zonis concentricis, vulgo discoloribus, fasciatus. Spora oblonga, alba. Lignatiles."

Polyporus lutescens Pers., the first species listed by Quélet under *Coriolus*, is accompanied by the citation of a figure, but this citation was but doubtfully given by Persoon in the original description and the recent investigations of Bresadola, who has examined Persoon's types, do not tend to confirm Quélet's opinion. The type of *Coriolus*, therefore, is *P. zonatus*, the first species accompanied by a correct citation of a figure.

The species of this genus are mostly thin, dry plants with a more or less zonate surface, which may be glabrous or variously adorned with hairs. White or yellowish colors prevail for both surface and context, only a few species showing light-brown or gray tints. The hymenium becomes wholly or partially fuscous in a few species, but it is generally white. The tubes are small and delicate, often breaking up with age. In some species there is an early fission of the dissepiments and the hymenium becomes irpiciform, as in the very common *Coriolus pargamenus.*

Work in this entire group has been rendered exceedingly difficult by the large number of "new species" published independently in former years from three or four European centers of research, each ignoring the existence of the rest. In the case of the present genus, these brief early descriptions are entirely inadequate and the poorly preserved type plants, when they exist at all, often fail to supplement them sufficiently.

Add to this the host of incorrect determinations found in the literature then current, the wholesale assignment of foreign names to plants exclusively American, and the glittering array of species in important herbaria combined under one name, and the systematist confronts a set of conditions unusually stringent where plants naturally closely allied are to be distinguished and new species described.

Synopsis of the North American species

1. Tubes more or less entire, at least until the sporophore is quite old. 2.
Tubes soon breaking up into long irpiciform teeth. 24.
2. Surface of pileus wholly or partly glabrous when mature or clothed only with inconspicuous hairs. 3
Surface of pileus clothed entirely with a very conspicuous hairy covering. 18.
3. Pileus not entirely glabrous at maturity. 4.
Pileus entirely glabrous at maturity. 10.
4. Pileus marked at maturity with glabrous zones of a different color from the rest of the surface. 5.
Pileus not marked with glabrous zones, but nearly uniform in color and not shining. 9.
5. Glabrous zones large, numerous, conspicuously and variously colored. 1. *C. versicolor.*
Glabrous zones small and comparatively inconspicuous. 6.
6. Surface villose between the zones, which are late in appearing; plants small, 1–2 cm. in diameter. 2. *C. hirsutulus.*
Surface minutely pubescent or tomentose between the zones; plants usually much larger. 7.
7. Hymenium white or yellowish. 8.
Hymenium fuscous. 3. *C. floridanus.*

8. Tubes small, 5 to a mm., and perfectly regular and entire. 4. *C. ectypus.*

Tubes twice as large, often irregular from splitting; glabrous zones late in appearing and sometimes absent. 5. *C. pubescens.*

9. Sporophore semiresupinate, shortly reflexed, tubes 1 cm. or more in length. 6. *C. subluteus.*

Sporophore wholly pileate, tubes less than 1 cm. in length. 7. *C. Sartwellii.*

10. Plants white or very light-colored. 11.

Plants more or less gray or brown. 16.

11. Hymenium lilac-colored, often faded in herbarium specimens. 8. *C. brachypus.*

Hymenium white or yellowish. 12.

12. Margin of pileus entire or lobed, not becoming fimbriate or lacerate. 13.

Margin of pileus very thin, becoming fimbriate or lacerate at maturity. 14.

13. Sporophore extremely thin and very flexible, with only one or two, if any, shining zones. 9. *C. haedinus.*

Sporophore thicker and quite rigid, with several shining zones. 10. *C. ilicincola.*

14. Tubes large, 2–3 to a mm., margin fimbriate. 11. *C. Drummondii.*

Tubes only half as large, margin lacerate. 15.

15. Sporophore dimidiate. 12. *C. membranaceus.*

Sporophore elongated, spatulate. 13. *C. Flabellum.*

16. Pileus marked with brown and black zones; temperate species. 14. *C. planellus.*

Pileus marked with brown and tawny zones; tropical species. 17.

17. Tubes 5 to a mm.; pileus 5 cm. broad, pale tawny, with darker brown zones; velvety zones present in young stages seem soon to disappear. 15. *C. armenicolor.*

Tubes 3 to a mm.; pileus 3 cm. broad, umbrinous-cinereous, subzonate. 16. *C. sobrius.*

18. Pileus 0.5 cm. or more in thickness and several centimeters wide. 19.

Pileus much thinner. 20.

19. Dissepiments obtuse, margin broadly sterile below. 17. *C. nigromarginatus.*

Dissepiments acute, margin but slightly sterile below. 18. *C. Sullivantii.*

20. Hymenium becoming wholly or partly fuscous, tubes broad and very shallow. 21.

Hymenium not becoming fuscous. 22.

21. Tubes regular in shape and size; plant tropical. 19. *C. pinsitus.*

Tubes irregular both in shape and size; plant confined to the southern United States. 20. *C. sericeohirsutus.*

22. Tubes large, 2–3 to a mm. 23.

Tubes small, 5 to a mm. 21. *C. arenicolor.*

23. Edges of tubes entire. 22. *C. hirtellus.*

Edges of tubes thin, serrate. 23. *C. tener.*

24. Plants large, 6–20 cm. wide and about 1 cm. in thickness. 24. *C. biformis.*

Plants much smaller and always very thin. 25.

25. Surface ashy-white, villose; plant confined to coniferous wood. 25. *C. abietinus.*

Surface wood-colored, tomentose; plant found on both deciduous and coniferous wood. 26. *C. pargamenus.*

1. CORIOLUS VERSICOLOR (L.) Quél.

Boletus versicolor L. Sp. Pl. 1176. 1753.

Polyporus versicolor Fr. Syst. Myc. 1: 368. 1821.

Polystictus azureus Fr. Nov. Symb. 93. 1851.
Coriolus versicolor Quél. Ench. Fung. 175. 1886.

Described originally by Haller from plants collected in Switzerland. Several other specific names have been given to European forms which need not be mentioned here. *P. azureus* was assigned by Fries to a thin, beautifully colored form collected at Mirador, Mexico, by Liebmann. It is no more distinct than a dozen other forms which might be mentioned and should receive similar treatment with them.

This species is cosmopolitan and exceedingly abundant on all forms of dead deciduous wood. Although numerous variations occur in its wide range, some of them sufficiently distinct, it seems, for specific rank, still the difficulty of going through the large accumulations of material from all lands in the different herbaria and satisfactorily separating it into groups is so great that it will probably not soon be attempted, especially since the species is so well defined by definite and easily observed characters.

Specimens have been examined from many widely different localities. Living plants have been observed throughout Europe and various parts of the United States. It is needless to attempt here a summary of collections at hand.

2. **Coriolus hirsutulus** (Schw.)

Polyporus hirsutulus Schw. Trans. Am. Phil. Soc. 4: 156. 1834.

Described from plants collected at Bethlehem, Pennsylvania, on trunks of trees, as follows:

> "P. minutus, dimidiatus aut reniformis, subinfundibuliformis etiam; substipitatus, coriaceus, ½ uncialis. Pileo strigoso-canescente griseo, fasciis notato ex pilis setosis, fuligineo-nigris, aggregatis in centro et in margine inflexo, inde ciliato. Poris pallidis subdecurrentibus."

This species is rather common on dead branches of *Sassafras* and is found more rarely on other forms of deciduous wood. One collection of it has been made also on white cedar. Authentic plants may still be seen in the Schweinitz herbarium. They resemble young sporophores of *C. versicolor* in which the zones have just begun to appear, but they are quite distinct from this species and more nearly allied to depauperate forms of *C. nigromarginatus*. The limits of the species need to be better understood. *Polystictus Fibula* Fr. is a close ally.

Material is at hand from Canada, *Macoun;* Connecticut, *Earle;* New York, *Earle;* Pennsylvania, *Michener;* New Jersey, *Ellis;* Ohio, *James*, *Morgan.*

3. CORIOLUS FLORIDANUS (Berk.) Pat.

Polyporus floridanus Berk. Ann. Mag. Nat. Hist. **10**: 376. 1843.
Polystictus Oniscus Fr. Nov. Symb. 82. 1851.
Coriolus floridanus Pat. Tax. Hymén. 94. 1900.

Described by Berkeley from specimens collected on decaying deciduous trunks in Florida. Described from Mexico and South Carolina by Fries in 1841, but not published until ten years later. Although Fries considered his plant distinct from Berkeley's, they cover the same territory and appear difficult to separate specifically.

This species occurs on oak logs and other deciduous wood in the southern United States from South Carolina to Florida and along the Gulf of Mexico to Texas. It much resembles *C. pargamenus* both in form and habit, but is readily distinguished by its grayish slate-colored surface and smoky hymenium. In some foreign herbaria it is confused with *Polystictus Friesii* Kl., a related species described from tropical America.

Specimens are at hand from South Carolina, *Ravenel;* Florida, *Ravenel*, *Martin*, *Lloyd*, *Small & Carter 1324*, *E. G. Britton 445;* Louisiana, *Langlois*; Texas, *Ravenel.*

4. CORIOLUS ECTYPUS (B. & C.) Pat.

Polyporus ectypus B. & C. Grevillea **1**: 52. 1872.
Coriolus ectypus Pat. Tax. Hymén. 94. 1900.

The type plants of this species were collected by Ravenel in South Carolina. It has since been found in other parts of the southeastern United States on decayed deciduous wood of various kinds. The following field notes made by Calkins in Florida are of interest as supplementing the rather brief published description:

"Tough, coriaceous, elastic, nearly plane, yellowish and nearly smooth above and multizonate with concentric, very shallow zones; 3–4 inches across, ¼ inch thick, margin acute, sterile beneath. Pores pallid-white changing to yellowish, especially around the margin, small, round, or in places distinctly sinuous, with a changeable luster, even on the surface and not at all lacerate, 2–3 millimeters long. Smell acid; plant somewhat juicy and moist when fresh."

Specimens are at hand from South Carolina, *Ravenel;* Georgia, *Ravenel;* Florida, *Rau*, *Martin*, *Calkins;* Louisiana, *Langlois.*

5. **Coriolus pubescens** (Schum.)

Boletus pubescens Schum. Enum. Pl. Saell. **2**: 384. 1803.
Polyporus pubescens Fr. Obs. Myc. **1**: 126. 1815.
Leptoporus pubescens Pat. Tax. Hymén. 84. 1900.

Originally described, from plants collected on white birch in Sweden in midsummer, as follows:

> "Cespitosus, imbricatus, pileo carnoso-suberoso, pulvinato, pubescenti, sericeo, albo, undulato-tuberculoso, margineque acuto luteo subferrugineo subzonato; subtus planus albido-pallescens: poris minutis marginem versus evanescentibus: tubulis brevibus. Caro alba. Pileus 1½–2½ poll. latus, 2–3 lin. crassus."

The margin of the American plant is usually more abrupt than that of the European, but the two agree too closely to allow of specific separation. Our plant has been distributed as a variety by Ellis, who at first gave the name of the collector to plants brought from Michigan in 1881 by J. B. Gray, thinking he had a new species. Upon the advice of Cooke, however, the name was reduced to varietal rank before distribution. So far as I know, no description has been published by Ellis either of the species or the variety.

This same plant was collected in Ohio and determined by Morgan as *P. molliusculus* Berk. The Berlin "type" of *P. molliusculus* is from Morgan. Kellerman, following Morgan, has recently distributed the present species under the name of *Polystictus molliusculus* Berk., with a printed description evidently not in accord with the specimens.

This species is very common in the northern United States and Canada on decaying wood of birch, beech, alder, willow, poplar, etc. Dearness found it abundant on rotten beech trunks at London, Canada, but the sporophores were mostly eaten to the bark by squirrels. Material is at hand from the following American localities:

Canada, *Macoun*, *Dearness;* Maine, *Ricker*, *Murrill;* Vermont, *Burt;* Massachusetts, *Blake;* New York, *Shear*, *Peck*, *Under-*

wood, Maxon & House; Ohio, *James, Lloyd, Kellerman;* Iowa, *Holway, Macbride;* Wisconsin, *Baker;* Michigan, *J. B. Gray.*

6. **Coriolus subluteus** (Ell. & Ev.)

Polyporus subluteus Ell. & Ev. Am. Nat. **31**: 339. 1897.

Described from plants collected by Dearness on old beech trunks in Canada as follows:

"Effused; pileus white, with short tomentum, azonate, subimbricate, margin obtuse, context soft and flexible, upper margin more or less reflexed; pores subcolliculose, unequal, round or subsinuous, ⅓–¾ mm. in diameter, ¾–1 cm. long, subluteous when dry, white inside, margin subdentate, dissepiments thin, context white, not fibrous; spores oblong, very slightly pointed, white, 4–6 × 1½–2 μ."

The type collection of this species is now in the herbarium of the New York Botanical Garden. Too little is known of the plant to be sure that it is not an overgrown resupinate form of some other species.

7. **Coriolus Sartwellii** (B. & C.)

Polyporus Sartwellii B. & C. Grevillea **1**: 51. 1872.

Described from plants collected on trunks in New York by Sartwell. Specimens from New England collected by Sprague were also at hand. There is in the Ellis collection a box of plants collected at Potsdam, New York, in January, 1861, which agree perfectly with the types of *P. Sartwellii* now at Kew. These plants grew on hemlock logs. Specimens collected by Underwood on pine at Centerville, New York, in April, 1887, appear to be specifically identical and show the hymenium to be yellowish instead of black, as in the description, becoming dull-brown with age. Nothing further is known of the species unless Léveillé's brief description of *Polyporus subflavus* (Ann. Sci. Nat. Bot. III. **5**: 300. 1846), collected on trunks in New York by Sallé, refers to the same plant; and this is quite improbable.

8. **Coriolus brachypus** (Lév.)

Polyporus brachypus Lév. Ann. Sci. Nat. Bot. III. **5**: 127. 1846.
Polyporus albo-cervinus Berk. Hook. Jour. Bot. **8**: 234. 1856.
Coriolus albo-cervinus Pat. Tax. Hymén. 94. 1900.

This species was first described from plants collected on trunks in Guadeloupe by L'Herminier. Berkeley's name was assigned to specimens from Panuré, Brazil, collected by Spruce. He remarks that it differs from *Polystictus Didrichsenii* Fr. (Nov. Symb. 76. 1851), found on the island of Bora-Bora, in its far smaller pores.

The present species is easily known by reason of its beautiful lilac-colored hymenium. It is quite well distributed in tropical America on decayed hardwood trunks.

Surinam, *James;* Brazil, *Spruce;* Nicaragua, *C. L. Smith;* Honduras, *Wilson 179, 560, 670;* Porto Rico, *Wilson 202;* Florida, *Bertolet, Britton 449.*

9. CORIOLUS HAEDINUS (Berk.) Pat.

Polyporus haedinus Berk. Hook. Jour. Bot. **8**: 234. 1856.

Polyporus undigerus B. & C. Jour. Linn. Soc. Bot. **10**: 317. 1868.

Coriolus haedinus Pat. Tax. Hymén. 94. 1900.

Described as follows from Panuré, Brazil, collected on decaying trunks by Spruce:

> "Albus, suborbicularis, postice decurrens, tenuis, papyraceus; pileo subtiliter pubescente sulcato-zonato; hymenio concolori; poris angulatis minutis; dissepimentis tenuibus."
>
> "An elegant species, allied to *P. hirsutus*, but much thinner, with finer pores and destitute of distinct hairs."

Twelve years later, Berkeley described the same plant from Cuba under another name, using almost the same words.

10. **Coriolus ilicincola** (B. & C.)

Polyporus ilicincola B. &. C. Grevillea **1**: 52. 1872.

Described from specimens collected by Peters in Alabama on the bark of *Ilex opaca.* The types at Kew are not well preserved. Specimens in the Ellis collection agree in all respects except the sinuate pores.

11. CORIOLUS DRUMMONDII (Kl.) Pat.

Polyporus Drummondii Kl. Linnaea **8**: 487. 1833.

Coriolus Drummondii Pat. Tax. Hymén. 94. 1900.

The type plants were collected by Drummond on trunks near New Orleans, Louisiana. Klotzsch saw them in Hooker's herbarium. They are now in a fair state of preservation at Kew. The plant has not since been collected in Louisiana and I have not seen anything closely resembling it in recent collections from the southern United States.

Specimens collected in Brazil by Möller are referred to this species by Bresadola (Hedwigia **35**: 281. 1896) with the following notes: "Species haec vegeta ex integro alba, postice longe resupinato-producta, interdum ex integro resupinata. Sporae hyalinae, subglobosae, 5 – 6 × 4 – 4½ μ; hyphae subhymeniale 3½ – 4½ μ latae, septatae." The identity of the two plants is doubtful.

12. CORIOLUS MEMBRANACEUS (Sw.) Pat.

Boletus membranaceus Sw. Prodr. 148. 1788. — Fl. Ind. Occ. **3**: 1922. 1806.

Polyporus membranaceus Fr. Syst. Myc. **1**: 370. 1821. — Berk. Ann. Mag. Nat. Hist. **10**: 378. *pl. 10. f. 7.* 1843.

Polystictus semiplicatus Ell. & Macbr. Iowa Bull. Nat. Hist. **3**: 192. 1896.

Coriolus membranaceus Pat. Tax. Hymén. 94. 1900.

Originally described from plants collected on dead wood in Jamaica as follows:

> "B. acaulis gregarius proliferus submembranaceus laevis radiatus albus, poris erosis difformibus."

This description is much enlarged in Swartz's later work. The species is exceedingly abundant in tropical America on all kinds of dead wood and large collections have been brought to the New York Botanical Garden in recent years, as the following list will show:

Porto Rico, *Earle, Underwood & Griggs, Heller, Wilson 39;* New Providence, *E. G. Britton 732;* St. Kitts, *Britton & Cowell 710;* Cuba, *Underwood & Earle 572, 853, 1318, 1374, 1376, 1575, Earle, Wilson, Murrill;* Jamaica, *Earle 232, 525, 601, 611, Underwood 2326, Miss Robinson;* Nicaragua, *Smith;* Colombia, *Baker.*

13. **Coriolus Flabellum** (Mont.)

Polyporus Flabellum Mont. Pl. Cell. Cuba. 388. *pl. 15. f. 2.* 1842.

Well described and finely figured by Montagne from plants collected on dead branches and trunks in Cuba. Types at Paris are well preserved. Although nearly related to *C. pargamenus*, it is quite distinct both in form and habit. It is more difficult to separate it from *C. membranaceus.*

14. **Coriolus planellus** nom. nov.

Polyporus planus Peck, Rep. N. Y. State Mus. Nat. Hist. **31**: 37. 1879. Not *P. planus* Wallr. 1833.

The type plants of this species were collected on dead branches at North Greenbush, New York. Only a few specimens are at hand: New Hampshire, *Blake*; Maine, *Murrill*; Iowa, *Holway*.

15. CORIOLUS ARMENICOLOR (B. & C.) Pat.

Polyporus armenicolor B. & C. Jour. Linn. Soc. Bot. **10**: 315. 1868.

Coriolus armenicolor Pat. Tax. Hymén. 94. 1900.

Described as follows from Wright's Cuban collections:

> "Pileo tenui subcoriaceo flabelliformi in stipitem spurium attenuato zonato velutino interstitiis lineatis; hymenio alutaceo; poris minutis, dissepimentis tenuibus dentatis."
>
> "On dead wood. Pileus 2½ inches across, 1¾ long; pores $\frac{1}{120}$ inch in diameter. The pileus is of a pale tawny or tan-color, with darker lines. Allied to *P. versicolor*."

Plants collected by Cockerell in Jamaica in 1890 correspond exactly with Wright's Cuban types at Kew except with respect to the zones of tomentum, which may be variable or evanescent in the species. More material may throw light on this matter.

16. **Coriolus sobrius** (B. & C.)

Polyporus sobrius B. & C. Jour. Linn. Soc. Bot. **10**: 316. 1868.

Described as follows from Wright's collections in Cuba:

> "Pileo imbricato flabelliformi opaco glaberrimo subzonato tenui umbrino-cinereo nebuloso; poris parvis laceratis."
>
> "On dead wood. Pileus $\frac{9}{6}$ inch wide, $\frac{5}{6}$ inch long; pores $\frac{1}{84}$ inch in diameter. Somewhat resembling *P. sector*, var. *zonarius*, but, I think, distinct."

The small thin purplish zonate type plants now at Kew appear quite distinct.

17. **Coriolus nigromarginatus** (Schw.)

Boletus hirsutus Wulf. in Jacq. Collect. **2**: 149. 1788. Not *Boletus hirsutus* Scop. Fl. Carn. ed. 2. **2**: 468. 1772.

Boletus nigromarginatus Schw. Syn. Fung. Car. 72. 1818.

Polyporus hirsutus Fr. Syst. Myc. **1**: 367. 1821.

Originally described from plants collected in Carinthia, where Wulfen found it very common on tree trunks in the forests and sometimes in orchards. His following brief description is accompanied by copious notes:

> "Boletus acaulis, semicircularis, plano-convexus, albissimus, supra hirsutissimus, lineis concentricis alternis depressis; subtus poris rotundato-angulatis."

Wulfen's name, however, is preoccupied by Scopoli for the plant usually known as *Polyporus hispidus* Fr. (see Bull. Torrey Club **31**: 594. 1904) and Schweinitz's name must be used for the present species. It was first applied to specimens collected on trunks of *Liriodendron* in North Carolina and afterwards on the same host in Pennsylvania, to which host Schweinitz thought it was confined.

It must be confessed that this form on *Liriodendron* looks distinct when seen in the field, being large and rigid, with short tomentum and a broad black marginal band; but I am convinced that this is an undeveloped stage, deserving possibly varietal, but not specific, distinction. Type plants in the Schweinitz herbarium appear fully developed and not at all unlike ordinary forms on other deciduous trees.

This species is very abundant throughout the United States and Canada on all kinds of decaying deciduous wood, the form on *Liquidambar* especially being very similar to that from the European type locality. In early summer the sporophores make their appearance as very dark brown hairy swellings on decayed wood or the remains of older pilei and grow rapidly into conchate fruit-bodies of tough elastic substance and hirsute surface marked with concentric zones of gray and brown. The hymenium may be yellowish or fuscous and the pores circular or irregular, with thin, dentate dissepiments equaling the thickness of the context in length. No shining glabrous zones make their appearance as is the case with *C. versicolor*.

Specimens too numerous to mention here have been examined from various parts of Europe, Asia and North America.

18. **Coriolus Sullivantii** (Mont.)

Polyporus Sullivantii Mont. Ann. Sci. Nat. Bot. II. **18**: 243. 1842.

Described from plants collected on fallen dead branches in Ohio by Sullivant and sent to Montagne by Asa Gray. Little is known of the species. Two collections made by Ellis in New York match the types at Kew. The pileus is orbicular to dimidiate, thin, coriaceous, concave beneath, with acute margin and villose, zonate surface. The tubes are unequal, of medium size, a millimeter or more in length, with acute, dentate dissepiments, which become pale fuscous with age. There is little to distinguish it from forms of *C. hirsutus.*

19. CORIOLUS PINSITUS (Fr.) Pat.

Polyporus pinsitus Fr. Elench. Fung. 95. 1828.
Polystictus umbonatus Fr. Nov. Symb. 87. 1851.
Coriolus pinsitus Pat. Tax. Hymén. 94. 1900.

Collected by Lund on trunks of trees in Brazil and described as follows:

> "Coriaceo-membranaceus, tenax, pileis hirtis concentrice sulcatis unicoloribus cinereis, poris curtis majusculis angulatis acutis inaequalibus albis."

Later described as *Polystictus umbonatus* from Liebmann's Mexican collections on account of the dark pores seen in these specimens. The hymenium varies from white to purple and smoke-colored in a way calculated to puzzle anyone not accustomed to its changes. Some specimens are half white and half dark beneath.

Few species are more abundant than this in tropical America. It may be found on dead wood of various forms and kinds, such as sticks, stumps and logs of bamboo, logwood, cocoanut, etc., throughout the West Indies and the warmer parts of Central and South America. The following list includes numbers of specimens recently added to the New York Botanical Garden herbarium:

Bolivia, *Rusby;* Ecuador, *Lagerheim;* Brazil, *Henschen, Lund;* Venezuela, *Gaillard;* Nicaragua, *Smith;* Mexico, *Liebmann, Smith;* Cuba, *Wright, Earle, Wilson, Murrill, Underwood & Earle 1117, 1482, 1503, 1509, 1517, Britton & Shafer 469, 473, 558, 774;* Jamaica, *Earle 95, 133, 135, 140, 159b, 231;* Porto Rico, *Goll, Earle 22, 43;* New Providence, *E. G. Britton 722;* Southern Florida, *E. G. Britton 465, Small & Carter 1331.*

20. **Coriolus sericeohirsutus** (Kl.)

Polyporus sericeo-hirsutus Kl. Linnaea 8: 483. 1833.
Hexagona sericea Fr. Epicr. 497. 1838.

Polystictus barbatulus Fr. Nov. Symb. 87. 1851.

Described by Klotzsch from North American specimens in the Hooker herbarium. The type collection of *Polystictus barbatulus* was made by Curtis in South Carolina on dead trunks of red cedar. Fries separated it from *Hexagona sericea* because of its large pores, not knowing that this species shows wide variation in the form and size of its tubes. The resupinate depauperate form is incorrectly called *Poria superficialis* of Schweinitz in the Fries herbarium.

This plant is distinct, easily recognized and confined to one host, *Juniperus virginiana*, on the dead trunks and branches of which it is quite common in the southern United States north to Virginia and west to Missouri. I have collected it in quantity near Elizabethtown, Tennessee.

Specimens have been examined from South Carolina, *Ravenel;* Georgia, *Ravenel;* Florida, *Rau, Calkins, Lloyd;* Louisiana, *Langlois;* Tennessee, *Murrill 456;* Kentucky, *Miss Price;* Missouri, *Demetrio.*

21. **Coriolus arenicolor** (B. & C.)

Polyporus arenicolor B. & C. Jour. Linn. Soc. Bot. **10**: 315. 1868.

Described as follows from Wright's collections in Cuba:

> "Pileo dimidiato postice decurrente papyraceo repetite zonato strigoso velutino, pallido, margine lobato; poris parvis angulatis, dissepimentis tenuibus; hymenio ochraceo."
>
> "On logs in woods. Pileus 3 inches wide, 1¾ long. Pores $\frac{1}{100}$ inch across. Allied to *P. pinsitus* rather than to *P. hirsutus.*"

This is a very abundant species throughout the West Indies, on dead sticks and logs of various broad-leaved trees. It has been confused with *C. velutinus* and with *C. haedinus*, from both of which it is quite distinct. Material is at hand from the following localities:

Cuba, *Earle, Wilson, Pollard, Murrill, Underwood & Earle 379, 571, 763, 1503;* Haiti, *Nash 25;* Jamaica, *Earle 24, 48, 60, 92, 138, 157, 159a, 336, 340, 486;* New Providence, *E. G. Britton 245, 730;* Southern Florida, *Small & Carter 1322.*

22. **Coriolus hirtellus** (Fr.)

Polystictus hirtellus Fr. Nov. Symb. 83. 1851.

Collected on trunks of trees in Mexico by Liebmann and described as follows:

"Pileo stuppeo-coriaceo effuso-reflexo, pilis subtilibus erectis strigosis hirtulo, primitus azono, demum versus marginem obsolete et concolori-sulcato, contextu albido, poris mediis rotundis angulatisque helvelo-pallidis, demum fuscescentibus."

The types are poorly preserved and difficult to distinguish from old plants of *C. nigromarginatus* or *Coriolopsis occidentalis.*

23. **Coriolus tener** (Lév.)

Polyporus tener Lév. Ann. Sci. Nat. Bot. III. 5: 139. 1846.

Described from plants collected on trunks in Guadeloupe by L'Herminier as follows:

"Pileo coriaceo reflexo membranaceo sessili orbiculari zonato hirsuto albo, margine ancipiti subtus sterili. poris hexagonis ore acutis intus extusque alutaceis, contextu albo."

"Chapeau quelquefois résupiné, mais le plus ordinairement réfléchi, large de 2 ou 3 centimètres, membraneux, flexible, à surface blanche, tomenteuse; pores d'un jaune tendre."

The types are at Paris. Very little is known of the species, though it appears distinct.

24. CORIOLUS BIFORMIS (Kl.) Pat.

Polyporus biformis Kl. Linnaea 8: 486. 1833.
Polyporus molliusculus Berk. Lond. Jour. Bot. 6: 320. 1847.
Polyporus carolinensis Berk. Hook. Jour. Bot. **1**: 102. 1849.
Polyporus chartaceus Berk. Hook. Jour. Bot. **1**: 103. 1849. — Grevillea **1**: 53. 1872.
Coriolus biformis Pat. Tax. Hymén. 94. 1900.

Originally described from specimens collected by Dr. Richardson on birch in North America as follows:

"Pileo effuso-reflexo coriaceo villoso candido zonato, poris mediis dentatis albidis. Imbricatus. Pileus 2–4 unc. latus, 1–2 unc. longus. Pori irregulares, interdum fusco-violascentes."

Polyporus molliusculus was described from Lea's collections in Ohio, *P. carolinensis* from plants collected by Curtis on oak and *Liquidambar* in South Carolina and *P. chartaceus* from specimens found by Curtis in North Carolina on the under side of fallen trunks and branches of *Liriodendron.* According to Berkeley and Curtis, *Irpex epiphylla* Schw. is also a synonym.

This species is common, widely distributed and conspicuous on various forms of dead deciduous wood throughout North America, being usually referred to by collectors under its earliest name, with *P. carolinensis* and *P. chartaceus* as synonyms. *P.*

molliusculus is here thrown into synonymy only after a careful examination of the original specimens, which fully warrant this disposition of a troublesome name.

Specimens are at hand from Canada, *Dearness;* New Hampshire, *Miss Minns;* New York, *Murrill;* New Jersey, *Ellis;* Delaware, *Commons;* Pennsylvania, *Barbour;* West Virginia, *Nuttall;* Florida, *Calkins;* Alabama, *Benson, Underwood, Earle;* Louisiana, *Langlois;* Ohio, *Lloyd;* Missouri, *Demetrio;* Kansas, *Cragin;* Iowa, *Macbride.*

25. CORIOLUS ABIETINUS (Dicks.) Quél.

Boletus abietinus Dicks. Pl. Crypt. Brit. **3**: 21. *pl. 9. f. 9.* 1793.
Boletus incarnatus Schum. Enum. Pl. Saell. **2**: 391. 1803.
Coriolus abietinus Quél. Ench. Fung. 175. 1886.

A good description of this plant is to be found in the Magazin für Botanik **12**: 19. 1790, presumably written by Schrank, but I hesitate to ascribe the species to him on the basis of this citation. It seems quite certain that *Sistotrema fuscoviolaceum* Pers. is a form of the present species; and, according to Bresadola, *P. caesio-albus* Karst. is not specifically distinct.

This species has been well known for a long time by reason of its abundance throughout the northern hemisphere on decaying wood of coniferous trees, none of which appear to be exempt from its attack. Of the large number of specimens examined, the following may be mentioned:

Finland, *Karsten;* Tyrol, *Bresadola;* Newfoundland, *Waghorne;* Canada, *Macoun;* New York, *Shear, Underwood, Peck;* New Jersey, *Ellis;* South Carolina, *Ravenel;* Georgia, *Harper;* Alabama, *Mell;* Cuba, *Underwood & Earle 1337;* Texas, *Ravenel;* California, *McClatchie;* Colorado, *Bethel.*

26. CORIOLUS PARGAMENUS (Fr.) Pat.

Polyporus parvulus Schw. Trans. Am. Phil. Soc. **4**: 157. 1834.
Not *P. parvulus* Kl. Linnaea **8**: 483. 1833.
Polyporus pargamenus Fr. Epicr. 480. 1838.
Polyporus laceratus Berk. Ann. Mag. Nat. Hist. **3**: 392. 1839.
Polyporus Menandianus Mont. Ann. Sci. Nat. Bot. II. **20**: 362. 1843.

Polyporus xalapensis Berk. Hook. Jour. Bot. **1**: 103. 1849.
Polyporus balsameus Peck, Rep. N. Y. State Mus. Nat. Hist. **30**: 46. 1878.
Polyporus pseudopargamenus Thüm. Myc. Univ. no. 1102.
Polystictus Pusio Sacc. & Cub. in Sacc. Sylloge Fung. **6**: 265. 1888.
Coriolus pargamenus Pat. Tax. Hymén. 94. 1900.

Originally described under the name in current use from specimens collected by the Franklin expedition on trunks of pine in arctic North America. A year or two later Berkeley described it from New Orleans, Louisiana, under the name of *Polyporus laceratus;* then Montagne found it among Menand's New York collections and gave it the name of the collector. If the form on conifers is specifically distinct from that on deciduous wood, then *Polyporus balsameus* Peck is a synonym of *P. parvulus* Schw. and *P. pargamenus* Fr., while *P. laceratus* holds for the form on oak, chestnut, etc. After examining growing specimens of both forms, however, I think it best to consider them specifically the same.

The above list does not complete the synonyms of this variable plant. According to Bresadola, *Polyporus dispar* Kalchbr. and *Polyporus simulans* Blonski should be added for the European forms; while there are probably half a dozen more from other regions. Specimens from North America have been variously determined as *P. elongatus* Berk., described from Manila, *P. nilgheriensis* Mont., described from India, and *Daedalea ferruginea* Schum., described from Denmark.

This species occurs in great abundance in North America on dead wood of oak, cherry, birch, chestnut, maple and other deciduous trees, often covering the sides of dead standing or fallen trunks, especially those of white oak, for almost their entire length. It is also found on pine, hemlock, fir, etc., especially in the northern forests where these trees abound, the typical host of both the Schweinitzian and Friesian plants having been a pine trunk.

It also occurs in Europe, where it appears to have been recognized only recently under its Friesian name. Bresadola reports it common in Hungary on poplar, oak and basswood and considers it cosmoplitan in one or more of its multiplied forms.

The following list of specimens examined is much abbreviated and deals almost wholly with American material: Maine, *Ricker*, *Murrill*, *Miss White*; Connecticut, *Miss White*; New York, *Peck*, *Underwood*, *Clinton*, *Murrill*; New Jersey, *Ellis*, *Britton*, *Murrill*; Delaware, *Commons*; Pennsylvania, *Stevenson*, *Barbour*, *Sumstine*, *Murrill*; Virginia, *Murrill*; South Carolina, *Ravenel*; Georgia, *Harper*; Florida, *Nash*; Louisiana, *Langlois*; Tennessee, *Murrill*; Wisconsin, *Baker*; Hungary, *Kmet*.

SPECIES INQUIRENDAE

Polyporus arcticus Fr. Epicr. 479. 1838.
Boletus cervinus Schw. Synop. Fung. Car. 70. 1818.
Boletus cinerascens Schw. Synop. Fung. Car. 73. 1818.
Polystictus cyphelloides Fr. Nov. Symb. 88. 1851.
Polyporus decipiens Schw. Trans. Am. Phil. Soc. **4**: 157. 1834.
Polystictus deglubens Cooke, in Sacc. Syll. Fung. **6**: 290. 1888.
Polyporus Friesii Kl. Linnaea **8**: 487. *pl. 11.* 1833.
Polystictus jamaicensis Henn. Hedwigia **37**: 280. 1898.
Polyporus Kickxianus Lév. Ann. Sci. Nat. Bot. III. **9**: 122. 1848.
Polystictus limitatus B. & C. Grevillea **1**: 54. 1872.
Polystictus nuceus Fr. Nov. Symb. 81. 1851.
Polyporus papyraceus Fr. Elench. Fung. 97. 1828.
Polystictus placentaeformis Cooke, Grevillea **15**: 24. 1886.
Polystictus Ravenelii Berk. & Fr. Nov. Symb. 82. 1851.
Polyporus Richardsonii B. & C. Jour. Acad. Sci. Phila. II. **3**: 224. 1856.
Polyporus scarrosus B. & C. Grevillea **1**: 52. 1872.
Polyporus subflavus Lév. Ann. Sci. Nat. Bot. III. **5**: 300. 1846.

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STUDIES IN NORTH AMERICAN POLYGONACEAE—I, II

By JOHN K. SMALL

NEW YORK
1906

[From the BULLETIN OF THE TORREY BOTANICAL CLUB **25**: 40-53. 1898; **33**: 51-57. 1906]

Studies in North American Polygonaceae.—I.

By John K. Small.

In 1892 I began a study of the family Polygonaceae with special reference to the genera *Polygonum* and *Eriogonum*. Since that time, having been asked by the editors of the proposed Systematic Botany of North America, to prepare the manuscript on the family for the text of that work, I have made a careful review of the group. The results of my studies in *Polygonum*[*] and *Polygonella*[†] have already been published and I intend, in the present paper and those of this series to follow, to publish some notes of general interest pertaining to the different genera of this fascinating family.

My studies have been furthered by the loan of a specimens and types from the Herbaria of the New York College of Pharmacy Harvard University, California Academy of Science, Missouri Botanical Garden and the National Herbarium. Professor Thomas C. Porter has contributed much valuable material of several genera, while Professor Edward L. Greene has generously placed the specimens of several of the species proposed as new in my hands, with the request that I describe them.

I.—NEW SPECIES OF ERIOGONUM.

Eriogonum depauperatum.

Perennial, slender, pale green. Stem woody, branched; branches tufted: leaves crowded; blades thinnish, linear-spatulate, 2–6 cm. long, obtuse or acutish, revolute, glabrous above, tomentose beneath; petioles slender, nearly ½ as long as the blades: scapes erect, 5–10 cm. tall, simple, sparingly pubescent or glabrate: bracts scale like, lanceolate: involucres 5–8 in a terminal head, tubular or tubular-turbinate, 3.5–4 mm. high, thinly tomentose; segments ovate, acutish, about ½ as long as the somewhat angled tube: calices pink, 2 mm. long, glabrous; segments unequal, the 3 outer broadly cuneate, undulate toothed at the truncate apex, the 3 inner cuneate, much narrower than the outer: filaments glabrous: achenes 3-angled.

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[*] Mem. Dept. Bot. Col. Coll. 1: 1–180.

[†] Bull. Torr. Club, 23: 406–408.

In dry soil on the Black Hills, South Dakota. Summer.

A species with the general habit of *Eriogonum pauciflorum*, but more delicate in all its parts. The leaves are more numerous than they are in its relative and the blades of a thinner texture, but the chief diagnostic character lies in the involucres; these organs are tubular or tubular-turbinate and twice as high as broad as compared with the campanulate involucres of *E. pauciflorum*, which are about as broad as high.

The original specimens were collected by Mr. Rydberg at Hermosa, in the Black Hills, South Dakota, June 23, 1892. Number 970. Altitude about 1,100 meters.

ERIOGONUM TENUE.

Perennial from a shubby base, slender, thinly tomentose to the flowers. Stems loosely branching, 5–10 cm. long: leaves crowded at the ends of the branches, linear or nearly so, 1–2 cm. long, obtuse or acutish, revolute, thinly tomentose, but less densely so above than beneath: scapes erect, simple, 5–10 cm. tall, furnished with a whorl of leaf-like bracts above the middle: involucres solitary tubes; turbinate; segments linear to linear-oblanceolate, obtuse, shorter than the tubes, spreading or reflexed: calices glabrous, pale yellow, 5–6 mm. long, narrowed into stipe-like bases; segments unequal, the 3 outer oblong-obovate, notched at the apex, the 3 inner spatulate, erose at the apex: filaments villous at the base: achenes 3-angled, villous above the middle.

In dry sterile rocky situations on the Columbia River, Washington. Spring and summer.

A species of slender habit, near *Eriogonum sphaerocephalum*, but distinguishable by the narrow, linear, strongly revolute leaves and the glabrous calices.

The original specimens were collected by Mr. Suksdorf, on the Columbia River, in West Klickitat County, Washington, May 15, 1884. Number 694.

ERIOGONUM PORTERI.

A dwarf perennial with glabrous or nearly glabrous foliage. Stems branched below; branches more or less densely tufted. sometimes gnarled: leaves firm; blades suborbicular or rhomboidal, 2–10 mm. long, obtuse or rounded at the apex; petioles as long as the blades or longer: scapes erect or ascending, 1–10 cm. long, simple: involucres glabrous; tube 2 mm. high, constricted at the middle, the recurved segments linear to oblanceolate, very unequal, longer than the tube: calices yellow, 6–8 mm. long at maturity; segments unequal, the 3 outer oblong-spatulate, often oblique at the base, the 3 inner cuneate-spatulate, slightly longer than the outer: filaments short, villous: achenes 3-angled.

On mountain slopes at high altitudes, Utah and Nevada. Summer and fall.

The specimens on which the above species is founded have erroneously been referred to *Eriogonum Tolmianum.* The stouter habit, the glabrous or almost glabrous foliage, the leathery leaves, the smaller involucres with their linear or oblanceolate segments and the less manifestly stipitate calices with their oblong-spatulate oblique outer segments, prevent it from being merged with *E. Tolmianum.* We have specimens as follows:

Nevada: Clover Mountains, September, 1868, altitude 3,000 meters. *S. Watson*, no. 1014.

Utah: Bear River Canon, August, 1869, altitude 2,900 meters. *S. Watson*, no. 1014. Uinta Mountains, September 25, 1879. *T. C. Porter.*

ERIOGONUM COVILLEI.

Perennial, dwarf, caulescent. Stems branched at the base; branches forming tufted mats, forking, 2–3 cm. long, usually gnarled: leaves densely crowded at the ends of the branches, spatulate, 4–8 mm. long, obtuse or acutish, villous-tomentose or canescent, sometimes glabrate above; petioles much shorter than the blades: scapes erect or ascending, 1–4 cm. long, topped by a 2–6-rayed umbel: bracts foliaceous, oblong or linear-oblong: involucres turbinate, villous-tomentose; tube 2 mm. high, slightly enlarged at the base, constricted near the middle; segments 6–10, spreading, linear-oblong, obtuse: calices golden-yellow, glabrous, about 3 mm. long; segments cuneate or the outer cuneate-obovate, all rounded at the apex or the inner retuse: filaments villous near the base: achenes 3-angled.

At high altitudes in the Sierra Nevada, California. Summer.

Among the many distinct species heretofore grouped under *Eriogonum umbellatum*, the present one is a conspicuous example The dwarf stature and habit debar it from *E. umbellatum*, while the peculiar villous or canescent tomentum of the foliage is unknown in that species.

The original specimens were collected on the high Sierra Nevada Mountains, California, in 1891, by Mr. F. V. Coville and Mr. F. Funston. Number 1656.

ERIOGONUM CROCEUM.

Perennial, shrubby below, tomentose. Stems spreading, 1–3 dm. long; branches often tufted: leaves clustered at the ends of the shoots; blades oval or orbicular-oval, 1–1.5 cm. long, obtuse, tomentose or glabrate above, abruptly narrowed at the base; petioles variable, some shorter than the blades, some longer: scapes erect, 1–2 dm. tall, simple, usually naked, except the whorl of leaf-like bracts subtending the compound umbel and one bract near the middle of the scape: involucres terminal, thinly tomentose; tubes broadly turbinate, 2–2.5 mm. long, finely ribbed; segments longer than the tube, unequal, usually broadest above the middle, acute: calices glabrous, golden yellow 5–6 mm. long, narrowed into a long stipe-like base; segments unequal, the 3 outer oblong, the 3 inner cuneate-spatulate, all obtuse: filaments villous below the middle: achenes 3-angled, 4 mm. long, sparingly villous at the apex.

A beautiful species hitherto confounded with *Eriogonum umbellatum.* It is easily distinguished by habit, and the peculiar compound umbel is at once diagnostic. The scape often bears one leaf-like tract near the middle and commonly produces a branch several centimeters below the base of the umbel. I note the following specimens: Idaho Plants, no. 3414, *Heller;* Burnes, Grant County, Oregon, September 28, 1896, *Brown;* Redfish Lake, Idaho, no. 420, *Evermann.* Ranges from 1,100 to 2,000 meters in altitude.

ERIOGONUM TRICHOTOMUM.

Perennial, rather slender, densely tomentose. Stems woody, branching; branches spreading, 1–2 dm. long: leaves chiefly confined to the ends of the branches, elliptic, oval or spatulate, 8–15 mm. long, obtuse, slightly revolute, somewhat less densely tomentose above than beneath; petioles much shorter than the blades: scapes erect or ascending, 1–2 dm. tall, topped by a simple 3-rayed umbel, 2 rays with a whorl of bracts at the middle, 1 naked, all much shorter than the rest of the scape: involucres terminal; tubes broadly campanulate, about 2 mm. high, ribbed; segments oblong, recurved, longer than the tube: calices yellow, glabrous, 5–6 mm. long; segments spatulate, rounded or slightly retuse at the apex, the 3 inner somewhat narrower than the 3 outer: filaments villous below the middle: achenes 3 angled, 4 mm. long, villous below the apex.

At high altitudes, Mt. Hamilton, California. Summer.

One of the rare Californian species at one time referred to

Eriogonum stellatum and later to *E. tripodum.* Professor Greene has lately said* that it cannot be associated with *E. stellatum*, and to prevent the excellent *E. tripodum* from becoming a composite species we must describe it as new. Besides the less strict habit and the broader leaves, the glabrous calices serve as a ready means of separation between this species and *E. tripodum.*

The original specimens were gathered by Professor Greene on the southern and western slopes near the summit of Mount Hamilton, California.

ERIOGONUM PULVINATUM.

Perennial, matted, densely woolly-tomentose. Stems much branched, woody below: leaves crowded, spatulate, 5–8 mm. long, obtuse, wooly; blades thick, slightly revolute, narrowed into winged petioles: scapes erect, 1–1.5 cm. long, topped by a head of several involucres: involucres turbinate-companulate, 3–4 mm. high, partially deciduous; segments 5 triangular, green, shorter than the hyaline tube: calices oblong-campanulate, 2.5–3 mm. long, villous within and without, the hairs often pointing downward; segments oblong, obtuse, erect, twice as long as the tube, the inner 3 narrower than the outer: filaments slender, exserted, villous at the base: style-branches elongated: achenes 2 mm. long, 3-angled, densely villous with tangled hairs.

In dry soil, southern Utah. Spring and summer.

A dwarf species belonging to a group peculiar to the higher altitudes of the Sierra Nevada Mountains. It is related on the one hand to *Eriogonum gracilipes* and on the other to *E. nivale.* The glandless peduncle is sufficient to separate it from the former species. From *E. nivale* it differs in the looser tomentum, the clustered involucres and the villous calyx-segments.

The original specimens were collected by Mr. M. E. Jones, at Milford, Utah, June 17, 1880. Altitude about 1,500 meters.

ERIOGONUM SISKIYOUENSIS.

Perennial from a shrubby base, nearly glabrous. Stems very short or sometimes several cm. long: leaves crowded at the ends of the branches, 5–10 mm. long; blades elliptic or oval, acute or acutish, glabrous above, slightly tomentose beneath, somewhat revolute, short-petioled: scapes erect, simple 3–8 cm. tall, furnished with a whorl of bracts above the middle: involucres cam-

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* Pittonia, 3:201.

panulate; tube 3.5–4 mm. high: calices yellow, glabrous, 5 mm. long, contracted into a stipe-like base; segments cuneate-spatulate, rounded at the apex, concave, the 3 inner narrower than the three outer: filaments villous below the middle: achenes 3-angled, glabrous.

In alpine regions, northern California. Summer.

Under the name *Eriogonum Tolmianum** Prof. Greene refers to this plant as a "neat and pretty alpine species," and this it is. However, the species does not represent Hooker's *E. Tolmianum*, and may be distinguished from it as well as from all its relatives in the *umbellata* group by the long, solitary pedicel which is subtended by a whorl of several bracts.

The type specimens were found by Prof. Greene on the Scott Mountains, Siskiyou County, California, August 22, 1876. Altitude about 2,500 meters.

ERIOGONUM VINEUM.

Perennial from a stout tap root, closely white-tomentose to the flowers. Stems branching; branches tufted, clothed with the persistent leaves or leaf-bases: leaves crowded; blades suborbicular or broadly oval, 5–8 mm. long, obtuse or rounded at the apex, abruptly narrowed or truncate at the base; petioles as long as the blades or shorter: scapes erect, 2–8 cm. long, simple: bracts lanceolate to ovate, united at the base: involucres 4–6 in terminal heads, vase-shaped, 4.5–5.5 mm. high, angled, constricted near the top; segments ovate, ⅓–¼ as long as the tube, the tips recurved: calices vinous-red or cream-colored tinged with vinous-red, finally 5–6 mm. long, glabrous; segments very unequal, the 3 outer oval, cordate at the base, the 3 inner spatulate, more or less crisped: filaments villous at the base: achenes glabrous, 3-angled, 4 mm. long; base acute; angles margined at the apex.

In the mountains, Oregon and California. Spring and summer. 1550–2500 meters.

Eriogonum ovalifolium together with several species has been unfortunate at the hands of most of the later authors in being made a group instead of a natural species. The present species is a conspicuous plant on account of the velvety white-tomentose foliage and the large heads of vinous-red flowers. Besides the peculiar color distinctions, the vase-shaped involucres and the large calices readily separate the species from *E. ovalifolium*.

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*Fl. Francis, 143–144.

I have the following specimens before me: California, near Rose mine, San Bernardino Mountains, altitude 2100 meters, June 17, 1894, no. 3170, *S. B. Parish*; Oregon, Powder River Mountains, altitude 2,500 meters, August 7, 1896, *W. C. Cusick.*

ERIOGONUM ROSULATUM.

Perennial, dwarf, canescent-tomentose. Stems much branched; branches densely tufted, forming matted cushions: leaves in densely crowded rosettes; blades ovate or suborbicular, 2–5 mm. long, obtuse, thick, closely tomentose, abruptly narrowed or truncate at the base; petioles shorter than the blades, dilated at the base: involucres sessile, or at maturity on scapes 1–1.5 cm. long, broadly turbinate, 3 mm. high, villous tomentose; segments about as long as the tube, unequal, lanceolate to ovate, obtuse: calices pink to vinous, 2.5–3 mm. long, glabrous, contracted into a short stipe-like base; segments firm, the inner and outer nearly equal, cuneate, retuse at the apex, especially the inner 3: filaments short, glabrous: achenes 3-angled, 2.5 mm. long, glabrous.

At high altitudes, near Mineral King, Sierra Nevada, California. Summer.

One of the few species in which the peduncle is wanting, or almost wanting, at least during the flowering period. The species is related to *E. marifolium*, the leaves resembling those of that form. The plants form compact cushions several centimeters in diameter, on account of the many short branches and the very densely imbricated leaves. The retuse calyx-segments, the glabrous filaments and glabrous achenes all serve to distinguish the two species.

The type specimens were gathered near Mineral King, in the Sierra Nevada Mountains, on the Death Valley Expedition, by Mr. F. V. Coville and Mr. F. Funston. Number 1549.

ERIOGONUM POLYPODUM.

Perennial, from a shrubby base. Foilage densely canescent-tomentose: stems much branched; branches spreading radially: leaves thick, crowded; blades loosely ovate to suborbicular, obtuse, revolute, sometimes glabrate above, abruptly narrowed or cordate at the base; petioles stout, shorter than the blades: scapes numerous, erect, 5–15 cm. tall, simple below, topped by a 3-6-rayed umbel, or a head: involucres sessile or their peduncles 1–5 mm. long, turbinate, 3–4 mm. high; segments 5–7, usually 6, oblong, obtuse, spreading: calices glabrous, about 3 mm. long; segments pink with a reddish rib, unequal, the 3 outer broadly oblong, the 3 inner cuneate-spatulate: filaments glabrous: achenes 3-angled, glabrous.

In dry soil, southern California. Spring and summer.

A dwarf species related to *Eriogonum marifolium*, the foilage of the two species being quite similar. The plants of *E. polypodum* that have come to my notice produce numerous scapes, each of which is topped by a head or a conjested umbel instead of the open more or less straggly umbel characteristic of *E. marifolium*. The broadly-oblong outer calyx-segments and the cuneate-spatulate inner segments together with the glabrous filaments all serve to distinguish the species here described as new from *E. marifolium*.

The original specimens were collected at Long Meadow, Tulare County, California, June 7–14, 1888, by Dr. Edward Palmer at an altitude of 2,200–2,800 meters. Number 204.

ERIOGONUM HARFORDII.

Perennial by horizontal rootstocks. Foliage floccose-tomentose: leaves basal; blades spatulate, 2–6 cm. long, obtuse, crispen, densely white-tomentose beneath, floccose or glabrate above; petioles longer than the blades: scapes erect, 8–10 dm. tall, simple below, forking above, stout: bracts somewhat foliaceous below, scale-like above, involucres sessile, solitary or several at the ends of the ultimate branchlets, turbinate-campanulate, 5 mm. long, fluted; segments triangular-ovate, obtuse: calices white or pink, 3.5–4 mm. long, villous at the base; segments unequal, the 3 outer orbicular-oval, the 3 inner cuneate, longer than the outer, all erose or crisped: filaments villous near the base: achenes sharply 3-angled.

On dry hillsides in valleys, Mendocina County, California. Summer.

Near *Eriogonum affine* but more robust and of stricter habit. The leaf-blades are broadest above the middle, the involucres twice the size of those of *E. affine* and the calices pubescent at the base as contrasted with the glabrous calices of its northern relative.

Named for Mr. W. G. W. Harford, who collected the specimens in company with Dr. A. Kellogg, in Long Valley, Mendocina County, California. Number 874.

ERIOGONUM MINIMUM.

A dwarf perennial with minutely canescent foliage. Stems branched; branches densely tufted, about 1 cm. long, clothed by the persistent leaves: leaves densely imbricated and crowded, the persistent ones of previous years, black, the fresh ones gray, spatulate or almost terete by the strongly revolute margins, obtuse, dilated at the base: peduncles erect, 5–10 mm. tall, simple; involucres solitary, turbinate-campanulate, 2.5 mm. high, fluted: segments triangular-ovate somewhat converging calices, villous at the base, 2.5–3 mm. long; segments unequal, the 3 outer segments oval, the 3 inner obovate, all obtuse: filaments villous at the base: achenes 3-angled.

At high altitudes in the Cascade Mountains, Washington. Summer.

This excellent little species has posed as *Eriogonum acaule*, but a casual observation is sufficient to demonstrate the impossibility of such a disposition. Besides its more slender habit, the white woolly pubescence in the case of *E. acaule* and the gray canescent pubescence in the case of *E. minimum* serve as a ready means of separation; further, the smaller fluted peduncled involucres and the calices villous only at the base cannot be specifically associated with the corresponding organs of *Eriogonum acaule*. The original specimens were collected on the Cascade Mountains, Washington, in 1882, by Mr. T. S. Brandegee. Number 372.

ERIOGONUM CLAVELLATUM.

Perennial from a thick, woody base, pale green. Stem gnarled, branched; branches clustered, thinly tomentose; leaves fleshy, strongly revolute, cylindric-clavate, 1–1.5 cm. long, obtuse, glabrous without; petioles slender, 1–2 mm. long, tomentose: peduncles club shaped, 1–2 cm. long, simple or rarely forked: bracts scale-like: involucres deciduous, long campanulate, 4 mm. long, rib-angled; segments acute, dark green, erect: calices glabrous, pink, (?) 3.5 mm. long, urn-shaped; segments saccate at the base, bent out at the middle, crisped, the 3 outer fiddle-shaped, apiculate, the 3 inner rather cuneate, narrower than the outer, acutish: filaments villous at the base: achenes 3-angled, glabrous.

On rocky hill, Barton Range, southeastern Utah. Summer.

A low and one of the more peculiar species, most closely related to *Eriogonum ericaefolium* and *E. bicolor* from which it can be separated by the club-shaped leaves and peduncles, the structure of these organs being unique in the genus. The branches of the inflorescence and the flowers are loosely articulated and easily fall away.

The type specimens were collected on the Barton Range, San Juan county, Utah, on July 13, 1895, by Miss Alice Eastwood. Number 132. (Distributed as *E. Mearnsii.*)

ERIOGONUM NODOSUM.

A white-tomentose shrub, .5–1.5 meters tall, with spreading, forking branches. Leaves small, 2–6 mm. long; blades elliptic or elliptic-ovate, acutish, revolute, narrowed into short petioles: bracts scale-like, acute or acuminate: involucres turbinate-campanulate, 2.5 mm. long, angled, sessile; segments broad, much shorter than the tube: calices glabrous, pink, 3 mm. long; segments rounded at the apex, the 3 outer oblong or obovate-oblong, the 3 inner cuneate: filaments villous below the middle: achenes 3-angled, scabro-pubescent above the middle.

In dry soil, Don Cabesas, California. Summer and fall.

A strongly marked and very conspicuous shrubby species related to *Eriogonum Pringlei* and its western homologue, but much more robust and sparingly branched. All parts of the inflorescence are at least one-third larger, while the calyx-segments are narrower than in *E. Pringlei*. The achene is scabro-pubescent above the middle as contrasted with the glabrous achene of its homologue

The original specimens were found at Don Cabesas, California, on November 1, 1890, by Mr. C. R. Orcutt. Number 1462.

ERIOGONUM PALLIDUM.

Perennial. Foliage clothed with a grayish-white tomentum: setm branching: leaves (lower ones not seen) alternate; blades linear-oblong to linear lanceolate, 1–2 cm. long, short-peteoled: scapes erect, topped by an umbel of three or more divisions, each division dichotomous or trichotomous below: bracts whorled, the lower linear, the upper scale-like: involucres sessile or some of the lower ones short-peduncles, obovoid, 2.5 mm. high, secund, somewhat crowded towards the ends of the branchlets; segments triangular to ovate, each surrounded by a scarious, half-circular ciliate margin: calices white to pink, glabrous, 2–2.5 mm. long, contracted into a very short base; segments unequal, the 3 outer oval or oval-obovate, retuse or notched at the apex, the 3 inner shorter and smaller than the outer, oblong or oval-oblong, rounded at the apex: filaments villous below the middle: achenes 3-angled.

In dry soil, northwestern Arizona and the Little Colorado River. Summer.

A peculiar pale tomentose species related to *Eriogonum effusum.*

The branching of the divisions of the scapes primarally separate the two species; that of the new species representing the scorpoid dichotomy, while that of *E. effusum* represents forked dichotomy.

The specimens on which the species is founded were collected by Walter Hough on the Fewkes Exploring Expedition in August and September, 1896, on the Moki Reservation, northeastern Arizona and the Little Colorado River. Number 30.

ERIOGONUM CURVATUM.

Perennial from a woody base. Stem branched, scaly, the branches tufted: leaves crowded at the ends of the branches; blades elliptic, 5–10 mm. long, acute or acutish, densely tomentose, short petioled; peduncles wire-like, 5–15 cm. long, curved, glabrous, simple below, forking above: bracts scale-like: involucres sessile, scattered towards the ends of the scapes, turbinate-campanulate, 2.5 mm. high, 5-angled; segments triangular, somewhat unequal, obtuse, erect: calices pink, glabrous, 1.5–2 mm. long; segments unequal, the 3 outer suborbicular, the 3 inner oblong, all rounded at the apex: filaments glabrous: achenes 3-angled.

At high altitudes, Long Meadow, Tulare County, California. Summer.

One of the numerous relatives of *Eriogonum Wrightii* and *E. trachygonum*, but more delicate in habit than either of those species. The lustrous wire-like scapes and glabrous filaments serve to separate it from its allies. The original specimens were collected at Long Meadow, Tulare County, California, at an altitude of 2,800 meters, July 7–14, 1888, by Dr. Edward Palmer. Number 207.

ERIOGONUM CLAVATUM.

Annual, acaulescent. Leaves basal; blades 5–13 mm. broad, much broader than long, undulate, strigose-hispid on both sides, cordate at the base or rarely truncate; petioles about twice as long as the blades, hispid: scapes erect, solitary, glaucous, forked above, the ultimate division filiform, the lower internodes more or less swollen above the middle: bracts scale-like: peduncles hair-like, ½ cm. long, spreading: involucres narrowly turbinate, very small, less than 1 mm. long; segments obtuse, as broad as long, shorter than the tube: calices densely hirsute less than 1 mm. long, the segments nearly equal, ovate-lanceolate, acutish: filaments glabrous.

Near *Eriogonum capillare* but leaf-blades much broader than long and the pubescent hispid. The smaller involucres and the hirsute calices are diagnostic.

The type was collected in the mountains or northern Lower California, August 8, 1884, by Mr. C. R. Orcutt.

ERIOGONUM GLAUCUM.

Annual, slender, acaulescent. Leaves basal; blades ovate or oval-ovate, 5–10 mm. long, obtuse, undulate-crisped, often inequilateral, softly hispid on both surfaces, obtuse or subcordate at the base; petioles 2–3 times longer than the blades, hirsute: scapes erect, solitary or several together, 1–6 cm. tall, glaucous, forked, the branches ascending or spreading: peduncles filiform, about 1 cm. long, more or less spreading: involucres glabrous, turbinate, 1 mm. long; segments oblong, obtuse, about as long as the tube: calices densely hirsute, 2 mm. long; segments lanceolate, acute, erect; filaments glabrous.

Closely related to *Eriogonum trichopes* and *E. inflatum*. Leaf-blades less rigid, less prominently nerved and more densely pubescent. Scapes more sparingly branched and involucres fewer than in either of its relatives. The lanceolate calyx-segments also serve to separate it from both relatives.

The type specimens were collected by Mr. C. R. Orcutt, in the Colorado Desert, in April, 1889.

ERIOGONUM CAPILLARE.

Annual, slender, acaulescent. Leaves basal; blades orbicular-ovate, 1–2 cm. broad, acutish or apiculate, finely undulate crisped, truncate at the base or subcordate, sparingly strigose on both sides; petioles about as long as the blades, tomentose: scapes erect, 4–5 dm. tall, simple below, forking above, the ultimate divisions filiform or hair-like, 1–4 cm. long, erect or spreading: involucres turbinate, about 1 mm. long, glabrous; segments 5 oblong or ovate-oblong, obtuse: calices glabrous, about 1 mm. long, long-exserted, urn-shaped, pink; segments oblong, slightly dilated at the apex and slightly revolute about the middle, the 3 inner somewhat narrower than the outer: filaments glabrous, short: achenes 3-angled, 1 mm. long; base swollen; beak slightly shorter than the base.

Another relative of *Eriogonum trichopes* and *E. inflatum*, but readily distinguished by the tomentose pubescence of the leaves as contrasted with the hispid pubescence of the two older species. The scapes are not symmetrically branched, but rather irregularly forking and the peduncles longer than in both relatives. The glabrous calices are also diagnostic.

The original specimens were received from Dr. Ebert, U. S. A., who collected them at San Carlos, Arizona, in September and October, 1893.

ERIOGONUM TRINERVATA.

Annual, slender, acaulescent. Leaves basal; blades suborbicular or orbicular-ovate, 1–2 cm. broad, obtuse at the apex, truncate or subcordate at the base, ciliate, pubescent with scattered hairs, conspicuously 3-nerved, these impressed above, prominent beneath; petioles hispid below, widely forking above, the ultimate divisions filiform: involucres goblet-shaped on spreading filiform peduncles 6–15 mm. long, glabrous, 1–1.5 mm. long, with an undulate border: calices deep pink, glabrous, nearly 2 mm. long; segments rounded at the apex, the 3 outer oblong, the 3 inner ovate: filaments short, glabrous: achenes 3-angled, glabrous.

In dry soil, Cimarron, Colorado. Summer.

A beautiful species related to *Eriogonum subreniforme*, but more robust in habit. In place of the densely tomentose leaf-blades of *E. subreniforme*, *E. trinervatum* has glabrous leaf-surfaces, except a few scattered hairs on the lower side. The blades are never cordate, as they are in its relative. The calices are at least twice the size, and the segments of the inner and outer series of entirely different shapes.

The type was collected by Professor Greene, at Cimarron, Colorado, August 25, 1896.

ERIOGONUM TURBINATUM.

Annual, stoutish, acaulescent. Leaves basal; blades suborbicular, variable in size, some about 1 cm. broad, others 3–4 cm. broad, all more or less apiculate at the apex, softly tomentose on both sides, deeply cordate at the base; petioles about as long as the blades and tomentose like them: scapes erect, stout, solitary or several together, 2–4 dm. tall, forking above, the branches ascending: bracts scale-like: peduncles ascending or spreading: involucres shorter than the peduncles, turbinate, 2 mm. long, glabrous; segments usually 5, broadly ovate, obtuse, scarious-margined, shorter than the tube: calices glabrous, pink, about 2 mm. long; segments unequal, the 3 outer suborbicular, cordate, filaments short, glabrous: achenes 3-angled, nearly 2 mm. long, with an obovoid base, beaked.

In habit *Eriogonum turbinatum* resembles *E. deflexum*, though more robust, while in floral characters it is allied to *E. Hookeri*. The suborbicular outer calyx-segments readily separate it from

E. deflexum, with which species it has been confused, while the manifestly peduncled narrowly-turbinate involucres debar it from *E. Hookeri*.

The type was found by Mr. Pringle on mesas near Tucson, Arizona, May 2, 1884. Dr. Palmer collected the species at St. George, Utah, in 1877. Number 430.

II.—A NEW GENUS OF POLYGONACEAE.

The mountains of southern California have yielded many interesting and peculiar plants; some of these have been carefully studied and properly disposed of, while others are still far from their true systematic positions. The plant known as *Oxytheca Parishii* is an illustration of the latter class. Leaving this species out of consideration for a moment, we will have two distinct strains in *Oxytheca;* the one extreme represented by *Oxytheca luteola* and the other by *Oxytheca perfoliata*. All known members of the group fall naturally into one or the other of the two divisions, save *O. Parishii*, and to include this in the genus necessitates a third subgenus and a great extension of the generic characters. The latter alternative was resorted to by Dr. Parry, the author of the species, but it seems to me unsystematic and confusing thus to extend simple and clear-cut genera to such an extent.

ACANTHOSCYPHUS.

Annual, slender, nearly glabrous, acaulescent herbs, with erect, wiry, forking scapes. Leaves basal, firm, denticulate with spinulose teeth, dilated at the base. Bracts scale-like, ternate, united at the bases, inclined to one side of the axes. Involucres turbinate, truncate, on wire-like peduncles, with 18–20 hard ribs which are prolonged into as many rigid acicular awns, these surpassing the tube in length. Flowers 5–14, of two kinds: staminate included: pistillate exserted. Pedicels subtended by linear or linear-spatulate bracteoles. Calyx glabrous, segments 6. Stamens 9, inserted at the base of the calyx. Embryo with a long, curved radicle and accumbent cotyledons.

A monotypic genus of southern California.

ACANTHOSCYPHUS PARISHII (Parry).

Oxytheca Parishii Parry, Proc. Davenp. Acad. Sci. 3: 176. 1882.

In dry soil, San Bernardino Mountains, California, altitude 1,400 meters, August 5, 1881. Number 993.

[From the BULLETIN OF THE TORREY BOTANICAL CLUB, 33: 51-57. 1906.]

Studies in North American Polygonaceae — II

JOHN KUNKEL SMALL

Eriogonum xanthum sp. nov.

Perennial (section *Flava*), dwarf, closely pale-pubescent. Stems (caudices) closely tufted, densely leafy, the lower portions densely clothed with the persistent leaf-bases: leaves numerous, crowded; blades spatulate, 1–2.5 cm. long, obtuse, somewhat floccose and greenish above, more closely pubescent and gray beneath, rather slender-petioled: scapes 3–5 cm. tall, simple, pubescent, like the upper surface of the leaf-blades: bracts spatulate, quite similar to the leaves, but usually 1–1.5 cm. long: involucres nearly sessile, capitate, turbinate, ultimately ribbed, about 4 mm. long; lobes triangular, about one fourth as long as the tube: calyxes yellow, becoming 8 mm. long, including the stipe-like base, which is about 1.5 mm. long, silky-pubescent without; lobes spatulate or the outer ones pandurate-spatulate: filaments copiously villous below the middle: ovary sparingly pubescent at the top; styles sparingly pubescent at the base: achenes about 5.5 mm. long.

Collected on Mt. Harvard, Colorado, August 17, 1896, by *C. L. Shear, no. 3789* (type), and on Gray's Peak, Colorado, August, 1873, by Mr. Woolson.

Related to both *Eriogonum flavum* and *E. aureum*, but differing from both of them in its longer slender base of the perianth and the glabrous, persistent leaf-bases.

Eriogonum umbelliferum sp. nov.

Perennial, with woody branching rootstocks (section *Umbellata*), bright-green. Stems represented by short caudices: leaves crowded on the caudices; blades spatulate to elliptic or oval, 1–4 cm. long, or rarely longer, glabrous or nearly so at maturity, except the floccose-ciliate margins, slender-petioled: scapes 6–28 cm. tall, each topped with a 2–6-rayed umbel, which is subtended by a whorl of foliaceous bracts: peduncles mainly 1–2 cm. long and closely pubescent during anthesis, larger and thinly pubescent at maturity: involucres campanulate, sometimes becoming turbinate-campanulate, 2–2.5 mm. long, the lobes fully as long as the tube and strongly reflexed: calyxes yellow or sometimes red-tinged in age, about 8 mm. long at maturity, including the stipe-like base, which is 2–2.5 mm. long; lobes spatulate to oblong-obovate, the inner becoming markedly longer than the outer: filaments copiously villous from above the middle to the base: ovary sparingly pubescent at the top; styles pubescent at least below the middle: achenes about 5 mm. long, the beak fully as long as the body, which is decidedly constricted at the base.

The type was collected west of Ouray, Colorado, September 9, 1901, by *L. M. Underwood, no. 177 b.* The species is apparently common in Colorado and has been collected in two other States, viz.:

WYOMING: Fort Bridger, July, 1873, *Porter.* Elk Mt., July, 1899, *Little & Stanton 171.* Fort Steele, May and June, 1901, *Tweedy 4396.* . Copperton, June, 1901, *Tweedy 4395.* UTAH: Wasatch Mts., August, 1879, *Jones 1411* and August, 1900, *Stokes.*

This species differs from its nearest relative, *Eriogonum umbellatum*, chiefly in its longer and more slender-stalked calyx and glabrous or nearly glabrous leaves.

Eriogonum Tetraneuris sp. nov.

Perennial (section *Lachnogyna*), silvery-gray and silky-tomentose. Stems (caudices) tufted, very densely leafy, 1–4 cm. long, the older portions thickly clothed with old dilated leaf-bases: leaves crowded; blades elliptic to oblong, 1–3 cm. long, acute or acutish, paler and more densely pubescent beneath than above; petioles as long as the blades or shorter, ciliate and dilated below: scapes 1–1.5 dm. tall, conspicuously more densely pubescent near the top than below, simple or rarely branched, the branch subtended by a leaf-like bract: involucres sessile, capitate, subtended by lanceolate or triangular bracts, campanulate, about 3.5 mm. long, silky; lobes ovate, obtuse, about one third as long as the tube: calyxes lemon-yellow, about 6 mm. broad, silky without; lobes oblong or oblong-cuneate, the inner rather broader than the outer: filaments sparingly villous at the base: ovary densely pubestent; styles glabrous: achenes not seen.

Collected near Pueblo, Colorado, May 15, 1900, by *P. A. Rydberg & F. K. Vreeland, no. 6324.*

Related to *Erigonum lachnogynum* but with capitate inflorescence, and in this resembling *E. villiflorum.* The involucres are slightly longer than those of *E. lachnogynum* and the calyx-lobes are not contracted below the middle. The pubescence of the upper part of the peduncle and that of the involucres is more appressed and silky than the pubescence of *E. lachnogynum.*

Eriogonum orthocaulon sp. nov.

Perennial with woody rootstock and caudices which are densely leafy at the ends (section *Heterosepala*). Leaves usually numerous; blades typically oval, mostly 1–1.5 cm. long, or rarely smaller, densely felty-pubescent, but usually rather more thinly so above than beneath, terminating long curved or somewhat curled petioles: scapes mainly 1–3 dm. long, simple, floccose, each terminating in a head of several involucres, which is subtended by minute or thick-subulated bracts: involucres turbinate, sometimes angled and thus turbinate-obpyramidal, about 7 mm. long, prominently ribbed, floccose, the lobes mostly broader than long and much shorter than the tube: calyxes ochroleucous, becoming 4.5–5 mm. long, the outer sepals suborbicular to ovate-orbicular, the inner linear-cuneate to pandurate, about as long as the outer: filaments slightly pubescent at the base: ovary and styles glabrous: achenes not seen.

The type was collected at Rifle, Garfield county, Colorado, June 23, 1900, by *Geo. E. Osterhout, no. 2125.* Specimens have been collected elsewhere as follows:

IDAHO: Foothills, June, 1892, *Mulford.* Blue Lakes, June 2, 1893, *Palmer 62.* Idaho Falls, July 4, 1901, *Merrill & Wilcox 782.* UTAH: Salt Lake City, May, 1869, *Watson 1016.* ALBERTA: Crow Nest Pass, August, 1897, *Macoun 24480* and *24481.*

This species is related to *Eriogonum ovalifolium* and *E. ochroleucum,* but from both of these it may be distinguished by the large involucres.

Eriogonum coloradense sp. nov.

Perennial (section *Capitata*). Depressed stems branched at the base; branches tufted, 1–4 cm. long, clothed with the persistent leaf-bases: leaves crowded; blades narrowly spatulate to linear-spatulate, 2–5 cm. long, blunt, slightly revolute, webby-pubescent above or at length glabrous, densely white lanate-tomentose beneath, except the prominent midrib, narrowed into petiole-like bases which are dilated and scarious at the base: peduncles simple, mostly surpassed by some of the leaves, relatively stout, lanuginous, the pubescence becoming floccose: involucres in heads terminating the peduncle, campanulate, about 5 mm. long, thinly woolly without; lobes suborbicular or nearly reniform, barely one third as long as the tube: calyxes pink or pinkish, fully 4 mm. long at maturity; lobes blunt, the outer broadly ovate or orbicular-ovate, the inner smaller than the outer, oblong, the midrib vanishing below the apex: filaments slightly pubescent near the base: ovary and styles glabrous: achene 3-angled.

Collected on Mt. Harvard, Colorado, 1896, by *Frederic E. Clements, no. 66.*

Related to *Eriogonum pauciflorum*, but stouter and larger in all of its parts. The peduncles are mostly shorter than the leaves, which generally have flat instead of strongly revolute blades. The involucre of this species is narrower and much longer than that of *E. pauciflorum* and has the tube proportionally longer and the lobes proportionally shorter. The calyx too is at least one millimeter longer than that of *E. pauciflorum.*

Eriogonum nudicaule (Torr.)

Eriogonum effusum nudicaule Torr. Pacif. R. R. Rep. 4: 132. 1857.

Related to *Eriogonum lonchophyllum* T. & G., differing in the larger calyx, the campanulate involucre and the revolute leaf-blades.

Eriogonum scoparium sp. nov.

Perennial, with woody rootstocks and more or less elongated caudices (section *Corymbosa*). Leaves rather few on each caudex, but sometimes apparently numerous on prolifically branched plants; blades linear to linear-spatulate, 2–5 cm. long, revolute, at least in age, densely lanate beneath, floccose above, relatively short-petioled, the sheathing bases of the petioles very densely woolly: scapes mainly 1–2 dm. tall, glabrous, glaucescent, each topped with a compound open cyme, the bracts very small, the lower ones often subulate-tipped: involucres broadly campanulate, 2.5–3 mm. long, and about as wide at the mouth, the lobes broad, decidedly shorter than the tube: calyxes pink or whitish, becoming 3.5–4 mm. long, the lobes oblong to obovate: filaments pubescent at the base: ovary and styles glabrous: achenes 2.5 mm. long.

The type was collected at Gunnison, Colorado, September 12, 1901, by *Underwood & Selby, no. 376;* other collections from Colorado are as follows: Gunnison, July 7, 1901, *Baker 254.* Denver, September, 1892, *Eastwood.*

This species may be distinguished from *Eriogonum nudicaule* and *E. lonchophyllum* by the long-peduncled involucres in the forks of the inflorescence and from *Eriogonum salicinum* and the following species by its campanulate involucres.

Eriogonum tristichum sp. nov.

Perennial with woody rootstocks and somewhat elongated caudices (section *Corymbosa*). Leaves rather few on each caudex; blades narrowly linear, oblanceolate or linear, 2–7 cm. long, usually revolute, floccose above, densely white-woolly beneath; sheathing bases of the petioles very densely white-woolly: scapes mainly 1–3 dm. tall, glabrous, except at the base, glaucescent, each topped with a compound cyme, the bracts very small except sometimes those at the first fork of the inflorescence: involucre turbinate, 2.5–3 mm. long, decidedly longer than thick, the lobes broadly rounded, much shorter than the tube: calyxes pink or whitish, becoming 4 mm. long, the lobes obovate to oblong-obovate: filaments sparingly pubescent at the base: ovary and styles glabrous: achenes about 2.5 mm. long.

The type was collected at Rosa, Colorado, June, 1899, by *C. F. Baker, no. 286;* other specimens have been collected in Colorado as follows: Black Cañon, Gunnison, September 1888, *Parry.* Mesa Verde, September, 1892, *Eastwood.* Arboles, June, 1899, *Baker, 287.* Parlin, August, 1891, *Smith, 53.* *Eriogonum tristichum* differs from its nearest relative, *E. salicinum*, in its larger and relatively longer involucre and the strongly revolute leaf-blades.

Eriogonum Fendlerianum (Benth.)

Eriogonum microthecum Fendlerianum Benth. in DC. Prodr. **14**: 18. 1856.

This species is related to both *Eriogonum corymbosum* and the following species but may be easily distinguished from either by its larger involucre.

Eriogonum divergens nom. nov.

Eriogonum corymbosum divaricatum T. & G. Pacif. R. R. Rep. **2**: 129. 1855. Not *E. divaricatum* Hook.

Like the preceding, this species is related to *Eriogonum corymbosum*, from which it may be distinguished by the larger more prominently lobed and scattered involucres, and the stiffly spreading branches of the inflorescence.

Eriogonum fusiforme sp. nov.

Annual (section *Pedunculata*), glaucous. Leaves spreading; blades suborbicular, 1–5 cm. in diameter, rounded or bluntly apiculate at the apex, with scattered hairs on both surfaces, or hirsute beneath, hirsute-ciliate; petioles longer than the blades, or shorter, hirsute: scapes solitary or tufted, 2–5 dm. tall, markedly inflated below the several or many inflorescence-branches: peduncles capillary, spreading, many times longer than the involucres, abruptly bent at the base: involucres turbinate, barely 1 mm. long, the lobes ovate, shorter than the tube: calyxes white or mainly so; lobes ovate, becoming 1.5 mm. long, closely pubescent: filaments glabrous: ovary and styles glabrous: achenes about 2 mm. long, the tips exserted.

Type collected at Grand Junction, Colorado, June 20, 1893, by *De Alton Saunders;* the species is also represented by the following specimens:

COLORADO: Palisade, May 29, 1894, *Crandall.* UTAH: St. George, 1877, *Palmer 434.* Bluffs near Green River, June 15, 1901, *Stokes.* ARIZONA: Peach Springs, June 28, 1887, *Tracy & Evans 315.*

This species differs from *Eriogonum inflatum*, its nearest relative, in the much smaller turbinate and few-flowered involucres and the usually numerous large and divaricate accessory inflorescence-branches.

Polygonum buxiforme nom. nov.

Polygonum littorale Small, Mem. Dept. Bot. Columbia Coll. **1**: 102. (excl. synon.) 1895. Not *P. littorale* Link.

Polygonum rubescens sp. nov.

Perennial or sometimes annual, glabrous, bright-green. Stems ultimately branched at the base and above it, the branches ascending or spreading, 1–5 dm. long, striate: leaves scattered; blades thickish, narrowly oblong to elliptic or nearly linear, mainly 1–2.5 cm. long; ocreae silvery, or brown at the base, at length lacerate: flowers usually several in a cluster: calyxes becoming 3 mm. long; lobes with whitish or pinkish margins: achenes triquetrous, 2–2.5 mm. long, dull and distinctly granulate or striate.

Type collected in sandy soil at Parlin, Gunnison County, Colorado, August 16, 1901, by *B. H. Smith, no. 55;* other specimens belonging here are as follows:

COLORADO: Larimer County, June 17, 1895, *Cowen.* IDAHO:

Kootenai County, August 26, 1892, *Sandberg, MacDougal & Heller 966.* NEVADA: Unionville, September 1867, *Watson 1055.*

A species related to *Polygonum ramosissimum*, from which however it differs in the smaller whitish or pinkish margined calyx-lobes and the smaller and rougher achene.

Persicaria omissa (Greene)

Polygonum omissum Greene, Pittonia **5**: 200. 1903.

This species is known from both Kansas and Colorado.

Bistorta bistortoides (Pursh)

Polygonum bistortoides Pursh, Fl. Am. Sept. 271. 1814.

Polygonum Bistorta oblongifolium Meisn in DC. Prodr. **14**: 126. 1856.

This species of *Bistorta* is common in the mountains of Colorado and also in the neighboring states.

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